بسم الله الرحمن الرحيم

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# "التصنيفات لإستراتيجيات التصنيع لشركات الحديد و الصلب في الأردن"

# "The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan"

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إشراف

الدكتور يزن خالد مقدادي

كانون الأول -٢٠١٣

# التصنيفات لإستراتيجات التصنيع لشركات الحديد والصلب في الاردن

# The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan

إعداد

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بكالوريوس هندسة صناعية، جامعة العلوم و التكنولوجيا الأردنية ٢٠٠٦م

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**كانون الأول ٢٠١٣**

## الإهداء

بسم الله الرحمن الرحيم

لَقَدْ أَرْسَلْنَا رُسُلَنَا بِالْبَيِّنَاتِ وَأَنْزَلْنَا مَعَهُمُ الْكِتَابَ وَالْمِيزَانَ لِيَقُومَ النَّاسُ بِالْقِسْطِ وَأَنْزَلْنَا الْحَدِيدَ فِيهِ بَأْسٌ شَدِيدٌ وَمَنَافِعُ لِلنَّاسِ وَلِيَعْلَمَ اللَّهُ مَنْ يَنْصُرُهُ وَرُسُلَهُ بِالْغَيْبِ إِنَّ اللَّهَ قَوِيٌّ عَزِيزٌ

صدق الله العظيم

إلهي لايطيب الليل إلا بشكرك ولايطيب النهار إلى بطاعتك ... ولاتطيب اللحظات إلا بذكرك ... ولا تطيب الآخرة إلا بعفوك ... ولا تطيب الجنة إلا برؤيتك

الله جل جلاله

إلى من بلغ الرسالة وأدى الأمانة ... ونصح الأمة ... إلى نبي الرحمة ونور العالمين ...

سيدنا محمد صلى الله عليه وسلم

إلى من علمني العطاء بدون انتظار ... إلى من أحمل أسمه بكل افتخار ... و أرجو من الله أن يمد في عمرك لترى ثماراً قد حان قطافها بعد طول إنتظار ... إلى والدي العزيز

إلى من كان دعائها سر نجاحي وحنانها بلسم جراحي ... إلى أمي الحبيبة

إلى من بها أكبر وعليه أعتمد ... إلى شمعة متقدة تنير ظلمة حياتي ...الى خالتي الغالية

الـــى أخوتي ... قتيبة و آية و عبادة و عبدالله و سيف و رند ... أحبكم

و الى كافة الاهل والاصدقاء

الباحث

**الشكر والتقدير**

الحمــدلله و لــه الشــكر علـــى إتمـــام هــذا العمــل و الصــلاة و الســلام علـــى خيــر الخلــق و البشر سيدنا محمد و على آله و صحبه و تابعيهم و تابع تابعيهم أجمعين.

يطيب لي أن أتقدم بجزيل الشكر و الأمتنان و التقدير لمن آمن بي و كان نبراسا لي طوال فترة دراستي الجامعية في مرحلة الماجستير لأستاذي الفاضل الدكتور يزن خالد عبدالله مقدادي المشرف على هذه الأطروحة ، الذي كان دائم النصح و التوجيه لي خلال فترة دراستي و إعدادي لرسالتي، و كانت لمتابعته الدائمة بالغ الأهمية في نجاحي في دراستي و الأثر الأهم لإتمام رسالتي.

و كمـا علمنــا شــاعرنا أحمـد شـوقي :"قـم للمعلـم وفِّـه التبجـيلا كـاد المعلـم أن يكـون رسـولا"، لا تسـعفني الكلمــات للتعبيــر عــن خــالص شــكري و تقــديري لمعلمـــي الأفاضـــل أســاتذي الأعــزاء و أخــص بالــذكر أســتاذي الــدكتور جمــال أبودولـــة، و أســتاذي الــدكتور حســن العيســى. و أتقــدم بالشــكر لأعضــاء لجنــة المناقشــة كـل مـن د.عبدالرسـول الحيـاني و د.حسام الشريدة ، لتفضلهم قبول هذه المناقشة ومقدرا لهم ملحوظاتهم القيمة.

كمــا اتقــدم بالشــكر للمشــاركين بالدراســة الــى المــدراء التنفيــذين و المــدراء المــاليين و مــدراء المصـــناع و مهندســـي المبيعـــات فـــي كـــل مـــن: شـــركة حديـــد الأردن و شـــركة المناصـير للحديـد و الصـلب و شـركة البتـراء للحديـد و الصـلب و شـركة الصـلب الوطنيـة و الشــركة العالميــة للحديــد و الصـــلب و الشــركة العامــة للحديــد التخصصـــي و شــركة صــناعة الحديـد والصـلب الأردنيـة لمسـاهمتهم بأنجـاح هـذه الدراسـة بتزويـدنا بالحقـائق و المعلومـات اللازمة للبحث ، و الى زملائي و زميلاتي و كل من رافقوني خلال فترة دراستي.

الباحث

Osama Mohammad Suleiman Al-Jarrah

# The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan

**Key Words:** Iron and Steel Manufacturing, Operations Management, Operations Strategy, Manufacturing Strategy, Taxonomies, Jordan.

## Abstract

The aim of this study is to identify the taxonomies of manufacturing strategies for the Iron and Steel corporations in Jordan over the period 2008 to 2012. During this period many challenges faced Jordanian Steelmakers: the global economic crisis in 2008 and the Jordanian economic recession in 2010, the Iron and Steel corporations were directed towards complying with vertical integration, and expansion to provincial markets.

This study is extended over a period of time; however, the previous studies have adopted snap shot self-reporting methodology, while this study depends on published facts via annual reports, financial statements, sales/production reports, and other statistical reports, furthermore, this study expands the concept of taxonomies to include the tentative, sustained, and emergent; wherever, the previous studies have reported the tentative taxonomies only.

A sample of seven out of fourteen Jordanian Iron and Steel corporations were surveyed; which represents about 80% of the Jordanian Steelmakers market share over the period 2008-2012. The research attributes where presented for the first time by quantitative facts. The research used K-mean cluster analysis to identify manufacturing strategic groups. The research used also special scale (standard deviation ranking method) to make reasonable and unified scale, the research identify these manufacturing strategic groups by manufacturing capabilities. The research used Kraskul Wallis test to find the effect of manufacturing strategic groups on actions and performance indicators.

Three approaches were presented: the tentative, sustained, and emerged taxonomies. According to tentative definition, three clusters were developed by three significant competitive capabilities, according to sustained definitions three manufacturing strategic groups were developed by three competitive capabilities, according to emerged definitions three manufacturing strategic groups were developed by one significant competitive capability. The research found decisions and performance was affected by tentative manufacturing strategic groups. This indicates that the Steelmakers in Jordan should take the operational decision more on considerations.

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# Chapter 1

## Thesis Introduction

Chapter 1

# Thesis Introduction

The main purpose of this chapter is to briefly introduce the research project to provide the interested readers and the field's superintendents with general overview of the study project. Accordingly, the research aim motivation, objectives, Gaps and contribution, and structure were discussed.

## 1-1 Research Aim and Motivations

This research aims to identify the taxonomies of Iron and Steel corporations manufacturing strategies in Jordan over the period 2008 to 2012. This period was chosen as result of both global economic crises in 2008, and its aftershocks which many local observers called it the Jordanian economic recession in 2010 (The Jordanian National Economic Conference, 2010).

Iron and steel sector is an important tributary for the national economy, and it has an influential role in the promotion of key sectors; this industry has been negatively affected by both global economic crisis and Jordanian economic recession. As result of that contemporary circumstances many the Iron and Steel corporations are progressing for expansion and oriented towards more adopting of vertical integration (arabsteel.com, 2011).

Accordingly, it is hope that this research will help the production and operation mangers and the decision-makers in Jordan to continue a consolidated vision of their Iron and Steel products in a well-designed and

state-of-the art strategy for the long run, in order to markup the provincial customer satisfaction, as well as to ameliorate the Iron and Steel manufacturing tactics for the short run.

Nowadays Jordanian industrial organizations found themselves facing enormous amount of challenges due to the global economic crisis and its consequences, which threw its shadow over several parts of the economical and societal segments for all Jordanian classes.

Accordingly, Iron and Steel industry is facing a lot of challenges as the enactment of several unsupportive laws such as when the prime minister administration imposed additional charges for environmental consideration for imported Iraqi metallic scraps' which ranging between 35JD to 50 JD per ton in March 2010 (almuharrir.net, 2010), the decision was revocated in June 2012 (Al-Rai, 2012).

Further, the government allows importing about 3,000 tons of steel rebar per month for particular Arab investors, which is associated with the Jordan free trade agreement (Alghad, 2012), thus depriving the local factories from competition. In addition, increasing the price of LPG has a major influence on the operational cost for manufacturing sector (Al-Rai, 2010). This adversity raised many concerns among Iron and Steel corporations (Arab-Today, 2011), this situation lead to signs of collapse even for among the major Jordanian Steelmakers (Al-Rai, 2013).

However, some Iron and Steel corporations looking towards increasing their production capacity, by utilizing upstream integration through constructing subsidiary or acquisition Iron and Steel smelters to produce steel billet using electrical arc furnace, while the government is tardy to enact laws to protect the local manufacturing industries, especially for the Iron and Steel industry, lately the government constitute a extra charging fees for imported steel that reaches 80 JD per ton (Al-Rai, 2013).

Despite the fact that states majority of observers consider the Jordanian economy is service oriented; Industry constitute the cornerstone of any economy, the manufacturing sector plays a key role for the Jordanian economy. The capital invested in manufacturing sector in 2006 formed 12% of the total capital invested (Ministry of Industry and Trade 2006), and its contribution in GPD in 2006 represents 19.93%, where the Iron and Steel industry contributes 0.61% of the total GPD (Department of Statistics 2006). Further, Jordan's Iron and Steel industry has pivotal role for both domestic service and manufacturing sectors compared to other mining industries (Department of Statistics, 2006). Moreover, the total contribution of the manufacturing sectors is 31.55% of the total production of the economic sectors, and the contribution of the Iron and Steel industry in total production reaches 1.02% (Department of Statistics, 2006).

One the other hand, Jordan is one of the countries in the Middle East and North Africa that has a noticeable, potential and aptitude manufacturing sector, and it has performed very well relatively to other developing-country regions (Arab research center, 2012).

Although, some of the Jordanian Iron and Steel manufacturers directed towards expanding their facilities and increasing their activities in order to enhance their market share beyond Jordanian boards to reach the Gulf region and increases its accessibility on its classical market in Iraq, Palestinian lands, and Saudi Arabia (Al-Rai, 2012).

## 1-2 Research Objectives

1- Using literature to operationally define the operational capabilities, actions, and performance indicators of the Iron and Steel corporations.

2- Constructing the conceptual Model for Iron and Steel Manufacturing Strategies.

3- Identifying the operational capabilities and actions adopted by the Iron and Steel corporations in Jordan over the period (2008-2012).

4- Identifying the taxonomies of Iron and Steel corporations according to **tentative**, **sustained** and **emerged** operational capabilities in Jordan over the period (2008-2012).

5- Identifying the significant actions made by the Jordanian Steelmakers to realize the taxonomies of manufacturing strategies by the Iron and Steel organizations in Jordan over the period (2008-2012).

6- Identifying the significant performance achieved by the Jordanian Steelmakers through realizing the taxonomies of manufacturing strategies for the Iron and Steel organizations in Jordan over the period (2008-2012).

## 1-3 Research Questions

The thesis is hoping to answer the following research question:

What are the **Tentative**, **Sustained** and **Emergent** Taxonomies of Manufacturing Strategies adopted by Iron and Steel Organizations in Jordan?

## 1-4 Research Contribution

### 1-4-1 Major contributions

Previous studies focused on reporting the taxonomies of operations strategies by using snapshot self-reporting methodology (e.g. Miller and Roth 1994, Kathoria 2000, Frohlich and Dixon 2001, Sum et al. 2004, Zhao et al. 2006, Martı´n-Pen˜a and Diaz-Garrido 2008, Grant 2013), so the previous studies didn't use quantitative quantities or published facts to presents manufacturing strategies variables in order to identify taxonomies of manufacturing strategies over single time period.

Accordingly, this study investigates the taxonomies of manufacturing strategies over an extended time period (2008-2012), further, the data used in this research obtained from secondary resource, on the other hand, the previous studies reported tentative taxonomies, while this project reports tentative, sustained and emerged taxonomies.

Moreover, the previous studies focused on identifying the taxonomies of operations strategies with limited concern about developing prediction or indicative models as (Moran and others, 2008) for these taxonomies, this issue is a research objective in this proposed research project.

### 1-4-2 Minor contributions

The taxonomies of operational strategy have been a research issue since 1990's, where the majority of literatures focus on comparison between different manufacturing sectors; (e.g. Miller and Roth 1994, Kathoria 2000, Frohlich and Dixon 2001, Sum et al. 2004, Zhao et al. 2006, Martı´n-Pen˜a and Diaz-Garrido 2008, Grant 2013), with limited concerns about certain sector in general and for Iron Steel manufacturing as a core Industry.

Furthermore, the previous studies focused on reporting the taxonomies of manufacturing strategies in developed countries; (e.g. Miller and Roth (1987) conducted to North American, a replicate study by Frohlich and Dixon (2001) conducted to North and South Americans, Western European, and Specific Asian countries), with limited concern about the practices in developing countries in general (e.g. Bülbül, 2011), and for Jordan as case in particular.

This project reports the taxonomies of manufacturing strategy for the Jordanian Steelmakers as single sector within developing county.

## 1-5 Thesis Structure

### Chapter 2 (Overview of Iron and Steel industry in Jordan)

This Chapter features a background for the research project, starting by presenting the Jordanian economics, then introducing the contribution for manufacturing sector, as well as the significant position of Iron and Steel industry to the Jordanian economics and its dimensions is discussed. A brief introduction for the Iron and Steel industry in the Middle East and South Africa is overviewed, and a summary for Jordan Iron and Steel industry also is addressed, ending with Iron and Steel manufacturing process to be familiar with technical strategies and terms.

### Chapter 3 (Taxonomies of Manufacturing Strategies)

The chapter discusses the methodologies presented by previous studies to formulate the conceptual model of taxonomies of manufacturing strategies; moreover, this chapter summaries taxonomies of manufacturing strategies.

### Chapter 4 (Research Methodology)

The chapter is a roadmap for the research project, which showed how to answer the research questions were answered; accordingly, this chapter discusses the different phases of this research project. The phases were categorized according to research objectives, so the data-collection and analysis methods used to realize the objectives are summarized.

## Chapter 5 (Iron and Steel manufacturing strategies Content)

The main purpose of this chapter is to achieve the first, second and the third objectives. The classifications of Iron and Steel manufacturing competitive capabilities, decision actions, and performance indicators were identified by reviewing the previous studies. Further, the relationship between capabilities, action and performance indicators are identified. Finally, suggested taxonomies developed in this chapter help to construct conceptual model of taxonomies of Iron and Steel manufacturing strategies, so navigating maps that link the capabilities with actions and performance indicators were developed by reviewing previous literature and secondary literature.

According to tentative, sustained and emerged definitions' the taxonomies for Iron and Steel manufacturing strategies' models are developed, this approach involves patterns of taxonomies of manufacturing strategies prediction models are presented at the end of this chapter.

## Chapter 6 (Data analysis and Results)

The main purpose for this chapter to identify the taxonomies for Iron and Steel manufacturing strategies' prediction models according to tentative, sustained and emerged definitions' using different analysis approaches.

Moreover, this chapter seeks to identify the significant actions made by each manufacturing strategic group, and the significant performance achieved by these industrial groups.

## Chapter 7 (Decision Support System)

The purpose of this chapter is to introduce Microsoft® Excel Spreadsheets' decision support system (DSS) was constructed that includes the prediction model of cluster analysis to indicate the taxons implemented by the user.

## Chapter 8 (Discussions)

The Purpose of this chapter is to discuss patterns of the taxonomies of manufacturing strategies (taxon prediction models). The discussion covers: the justification of the relations between model variables, the competitive capabilities needed to realize the tentative, sustained and emerged manufacturing strategies groups, and how the Iron and Steel corporations made their decision actions to achieve niche in steel market share, and how they affect other performance predictors regarding realized industrial groups.

## Chapter 9 (Conclusions, Implementations and Future Research)

Conclusion of the research is presented, then the theoretical and practical implementation are implied, the pragmatic implementation concentrated on how Iron and Steel manufacturers in Jordan could benefit from the taxonomies of manufacturing strategies patterns (taxon prediction models). The theoretical implementations concentrated on the methodological and fundamental implementations, next the suggested researchers are recommended.

## 1-6 Summary

This research aims to identify the taxonomies of manufacturing strategies adopted by Iron and Steel corporations for their manufacturing strategies in Jordan during the period 2008 to 2012. Six objectives were identified to achieve the research aim and one research answer question is identified.

The research introduces the **Tentative**, **Emergent** and **Sustained** Taxonomies of Manufacturing Strategies for the first time according to the researched knowledge best knowledge. The project wills identifies these taxons using prediction models which will includes the capabilities, actions and performance indicators of the Jordanian Iron and steel corporations. The research will realize the significant manufacturing capabilities, actions and the critical performance indicators that Iron and Steel corporations should adopted in order to adopt core competencies, reasonable decision actions, and to achieve superior performance. This research includes 9 chapters.

# Chapter 2

## Overview of Iron and Steel industry in Jordan

Chapter 2

# Overview of Iron and Steel industry in Jordan

## 2-1 Introduction

This chapter introduces the Iron and Steel industry in Jordan. It includes the technical jargons used in that sector to make the reader familiar with the Iron and Steel industry significant terms, as well as, the chapter provides the reader with more insight about external and the industrial environment surrounds the Iron and Steel industry. This chapter contains five sections, starting with an overview of Hashemite Kingdom of Jordan, in this section general characteristics for Jordan are discussed, and a description for Jordanian social and economic positions relative to provincial countries in the Middle East and North Africa are indicated.

Then, a brief overview of Jordan manufacturing sector in general, including the Iron and Steel industries in particular were presented, and their contributions to the Jordanian economics through economical indicators. Ending with Iron and Steel manufacturing process technologies adopted within Jordanian Iron and Steel corporations.

## 2-2 Overview of Jordan

Officially well known as the Hashemite Kingdom of Jordan, it located in the Middle East, it's a constitutional monarchy of appointed government, consists of three powers: the executive, the legislative, and the judicial authority. Jordan borders Saudi Arabia to the south and east, Iraq to the north-east,

Syria to the north and Palestine along the Jordan River to the west (see (Figure 2-1)).

In 25th May 1946 the desert Kingdom become independent from the British Mandate and the emirate of Transjordan become which known as the Hashemite Kingdom of Jordan, at present day Jordan is classified as a country of medium human development (Human Development Report 2011).

Despite of its limited resources, the Kingdom shared the emerged market and ranked to be the third freest economy in West Asia and North Africa (32nd freest worldwide) (Heritage.org, 2012), considerably it is an upper middle income economy (worldbank.org, 2012), Jordan is a founding member of the Arab League (arableagueonline.org, 2010), and one of the first countries joined the Organization of Islamic Cooperation (OIC), and it is also a member of the Euro-Mediterranean free trade area. In 2000, Jordan joined the World Trade Organization and signed the Jordan–United States Free Trade Agreement (times, 2000).

The Largest city is Amman which is also the capital of Jordan. The official Language is Arabic, while the Arabic represents the dominant ethnic group by 98%, there is still other ethnic groups of Circassia and Armenian representing 2% to the total population (Department of Statistics, 2011). Islam is the official and dominant religion in Jordan, but all other faiths include Christianity and Druze are allowed to practice their religion (minority religion are forbidden in Jordan). The official and native language is Arabic; 2nd income is the English which is touch as primary subject starting from the 1st grade continued to the secondary level.

Jordan occupies 89,342 km$^2$ (35,637 square miles), with scare water area of 330 km$^2$ which represents 0.8% of the total area (Ministry of Tourism and Antiquates, 2010). The Total population of Jordan is 6,508,887, with density 68.4 for km$^2$ (138.8 for every sq mi), and annual population growth rate approximately 3.4 percent. Recently Jordan suffers from Forced migration due to the regional events, especially the Syrian crisis that increase later a heavy burden on the Jordanian economy.




Figure (2-1) the Hashemite Kingdom of Jordan (University of Texas Libraries, 2004)

Concerned about The Jordanian economics figures', the economical growth is at a mean rate of 4.3% per annum since 2005. Approximately 13% of the population lives on less than 2JD a day. The estimation for GPD is $36.893 billion in 2011 (worldbank.org, 2011). While the Jordanian economy suffers from insufficient supplies of water, oil, and other mineral resources, with many other constraints such as outstanding budget deficit, high general public debt, uncounted of poverty statistics and high unemployment rates (ministry of labour, 2011). That lead to conclude there is many challenges surrounds our Jordanian industries, on the other hand, Jordan has many potential opportunities can be achieved by utilizing its human capital where it suffers from a brain drain of its most talented workers (Al-Edwan, 2013), along with its unique natural resources through enhancing the infrastructure for the economical and the industrial base.

Jordan usually runs annual budget deficits, which are partially offsets by international aid and remittances from Jordanian expatriates are a major source of foreign exchange.

Jordan has relatively diversified economy. Many researchers found Jordan oriented towards to service economy, Trade and finance combined accounted for nearly one-third of GDP; transportation and communication, public utilities and construction accounted for one-fifth, and mining and manufacturing constitute nearly that proportion Department of Statistics, 2011). Despite plans to increase the private sector share, the state remains the dominant force in Jordan's economy. The government employs between one-third and two-thirds of all workers (ministry of Labour, 2011).

Service sector is the dominant sector in Jordan which contributes 67% of the GDP. The service sector includes the construction sector which is complementary with other manufacturing sectors such as cement industry along with the Iron and Steel manufacturing which is our research scope, on the other hand, there are other service sectors is considerably derogatory to Iron and Steel industry such as; Health sector where Jordan occupies a pioneer position in comparison with other provincial countries. In addition to service sectors, the Education sector has achieved a high recognition considerably significant in comparison to neighbor countries. Also Jordan has many other devolving sectors such as telecommunications, transportations, not forget to mention the hotel and tourism sectors.

In construct, the Industrial sector also plays significant role for the Jordanian economy, providing the service escape through manufacturing products, also the Industrial sector existing for itself which will discussed in next section.

## 2-3 Overview of the Iron and Steel industry in Jordan

Manufacturing sector is a key pillar for the Jordanian economy contributes about a quarter of GDP directly, in addition to its association with a number of other economic sectors. This sector is responsible for recruiting many of the skillful and adroit Jordanian labor force, and provides opportunities for rehabilitation, training and development, which work on the technical upgradation and enhances the utilization of human capital, with an estimated labor involved in it (15%) of the total workforce (ministry of labour, 2011). And contribute to cover part of the balance of trade deficit by exports, which

constitute an important part of total exports and industrial exports is estimated at 90% of the total commodity exports (Chamber of Industry, 2011).

According to Jordan Chamber of Industry; Industrial sector in Jordan is divided into three main categories, which are:

- The manufacturing industry: it contributes 20% of GDP, and it include many industries such as: therapeutic and medical supplies manufacturers, plastics and rubber, chemical, cosmetics, leather industries and Garments, wood industries, furniture, engineering industries, electrical and information technology, construction industries, ration and food industries, packaging industry, paper and cardboard and office supplies.
- Extractive sector: that includes mining and contributes a (3.0%) of GDP.
- Electricity and water sector: The contribution of this sector to the GDP (2.0%).



**2-3-1 Iron and Steel industry contribution to GDP**

Starting from the capital formation of the manufacturing sector which is about 351,305 thousands JD and 11,995 thousands JD for the Iron and Steel industry alone (department of statistics, 2006), the Iron and Steel capital formation decreased by 30% in 2011 to reach 8,340 thousands JD while the capital formation of manufacturing sector increased more than 200% (department of statistics, 2011). The total contribution of the manufacturing sectors in the GDP 19.93% of the total contribution of economic sectors

(department of statistics, 2006), while the percentage contribution of the iron and steel industry in GDP 0.61% (department of statistics, 2006), which led the iron and steel industry to be ranked 34 among the top economic sectors contribution to the GDP and the 81 sub-sectors (*see figure 2-2* (department of statistics, 2006)).

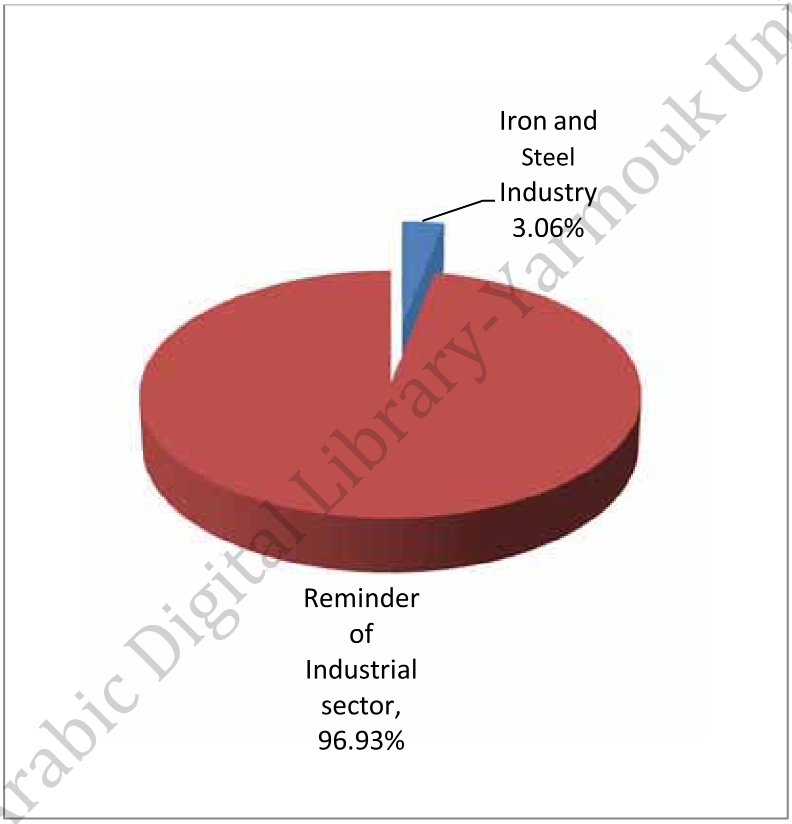



Figure (2-2) Iron and Steel Industry contribution to GDP along with Industrial Sector (department of statistics, 2006)

### 2-3-2 Iron and Steel industry contribution in total production

The total contribution of the manufacturing sectors is 31.55% of the total production of the economic sectors, where the percentage contribution of the iron and steel industry in total production is 1.02% ((*see figure 2-3* (Department of statistics 2006)). so the iron and steel industry is ranked among the top 26 economic sectors contribute to the total production and its ranked the 81st place among sub-sectors. Also the iron and steel industry ranked 8th out of the top manufacturing sectors contribution to the total production and the 46 sub-sectors.

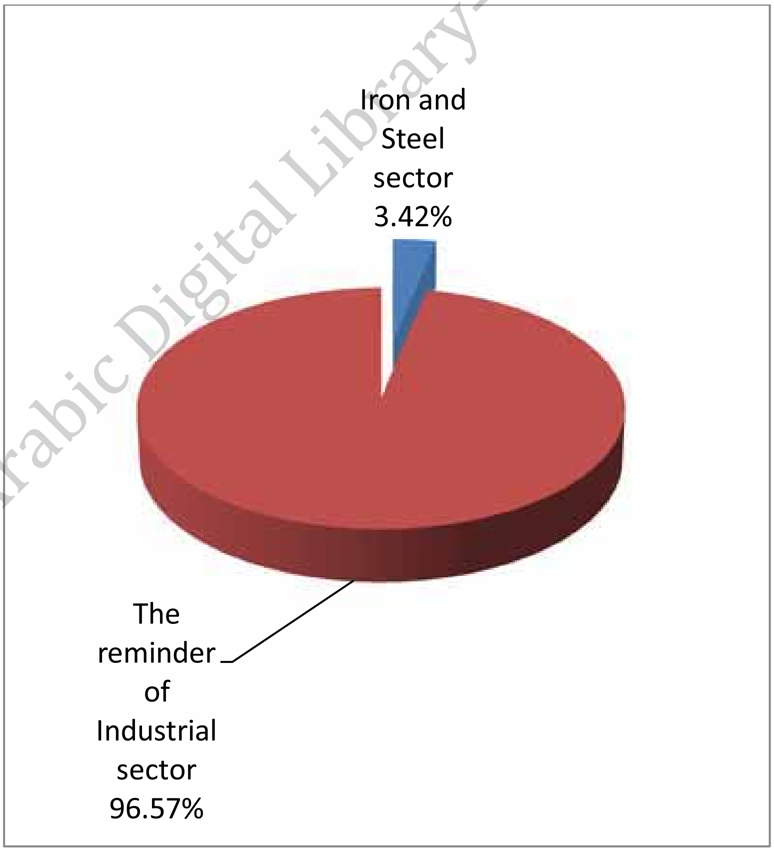



Figure (2-3) the total contribution Iron and Steel sector along with Industrial sector to total production of the economic sectors (Department of statistics 2006)

### 2-3-3 Iron and Steel contribution to added value

The share of value added by the iron and steel industry is 84,359 thousands JD to overall added value for all manufacturing sector which is 2,359,866 JD, which makes the Iron and Steel industry to represents a 3.06% from overall added value within manufacturing sector, so ranked the 9th place (department of statistics 2006). (*see figure 2-4* (department of statistics 2006)).

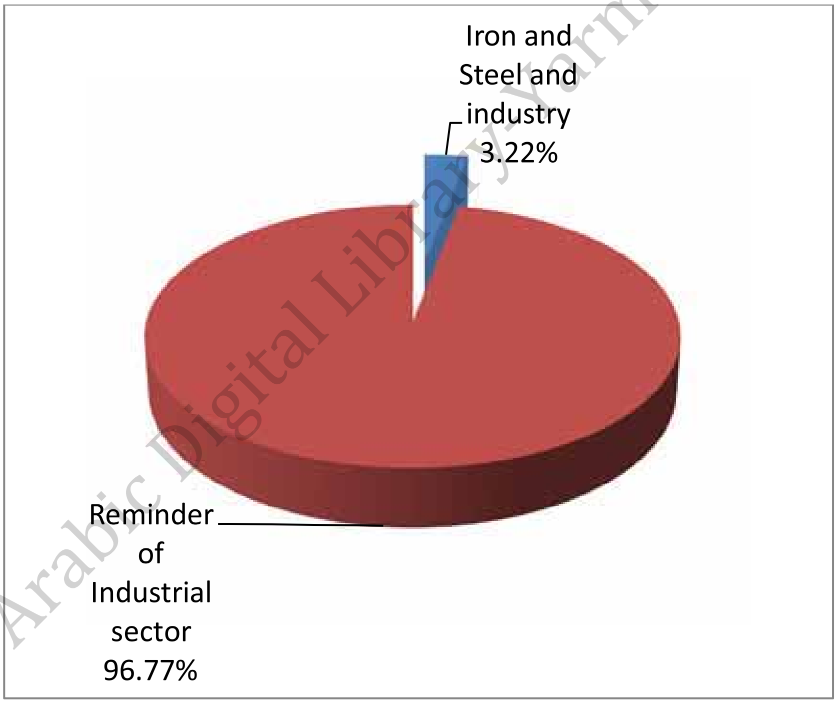



Figure (2-4) added values for Iron and steel industry (Department of statistics 2006)

### 2-3-4 Iron and Steel industry contribution to compensation of employees

Distributed economic sectors contribution for the compensation of employees increased by 16.17% for manufacturing sectors and 83.83% for the rest of the other economic sectors. The contributions of the iron and steel industry to the compensation of employees is 0.37% (*see figure 2-5*). That led the iron and steel industry to be ranked 40 among the economic sectors contribute to the compensation of employees and the 81st among the sub-sectors .Also lead the iron and steel industry ranked among the top 17 manufacturing sectors contribute to the compensation of employees and the 46th among the sub-sectors.

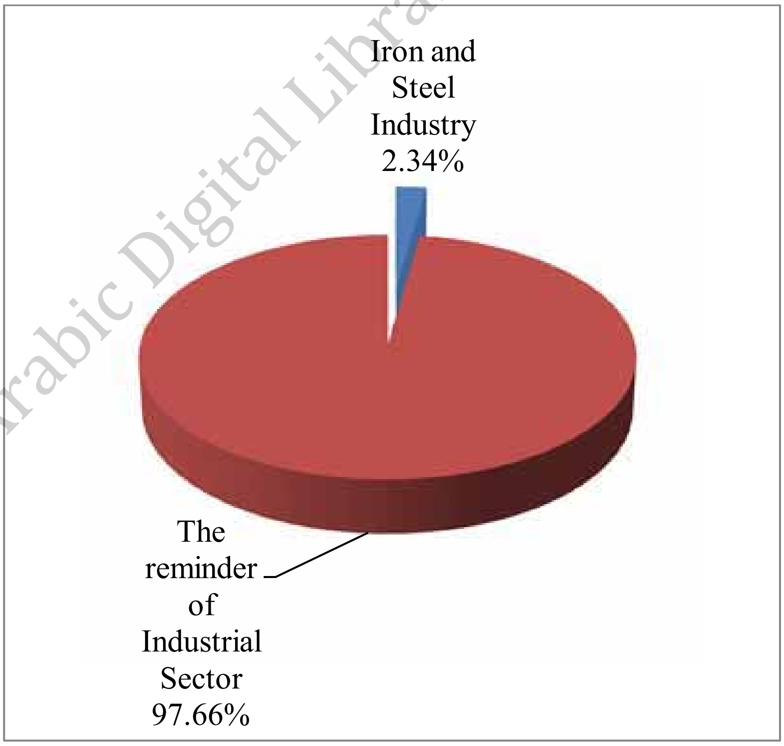



Figure (2-5) the compensation of employees with Industrial sector and Iron and Steel corporations (Department of statistics 2006)

### 2-3-5 Iron and Steel industry contribution to Jordanian national exports

In result, the total national exports of the Jordanian economy nearly 6 billion Jordanian dinars. The contributions' distributions to the economic sectors due to the national exports are divided into 51.41% of the manufacturing sectors and the 46 sub-sectors and 48.59% for the rest of the economic sectors. The percentage contributions of the iron and steel industry in the national exports 0.62% (*see figure 2-6*). That led the iron and steel industry to be ranked 35 among the top economic sectors contributes to the national exports and the 81 sub-sectors. That lead the iron and steel industry ranked among the top 20 manufacturing sectors contribute to the national exports and the 46 sub-sectors.



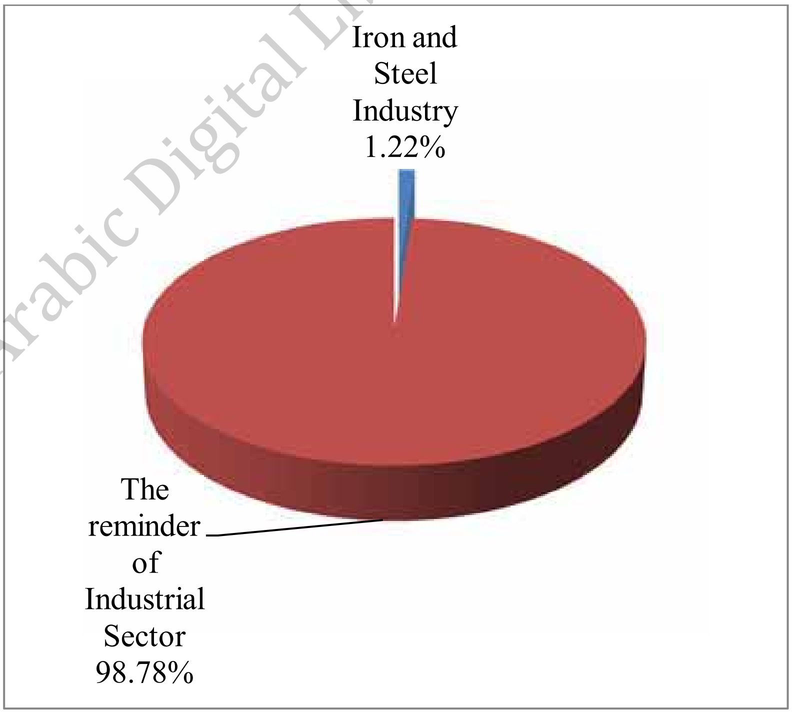



Figure (2-6) Iron and Steel corporations contributions to exports for industrial sectors

(Department of statistics 2006)

### 2-3-6 Iron and Steel industry complimentary industries

The construction sector led to the first rank; because it is more commonly used for the production industry, iron and steel (47.19%), and the sector was the iron and steel industry users of its production in the second place with 24.16%, and electrical machinery sector ranked third with 9.27%. Sort sector's contribution to the iron and steel industry within the sub-sectors of the Jordanian economy showed (Department of statistics 2006).

The observed distributions of production sector iron and steel industry between intermediate consumption by 93.06%, and the components of final demand by 6.94 percent. Highest 5 economic sectors used for the production of iron and steel industry table 2-1*:

Table (2-1)* Iron and Steel industry usage percentile to complimentary industries

| Num | Economic sector | Usage percentile % |
|---|---|---|
| 1- | Construction | 47.19 |
| 2- | Iron and Steel Industry | 24.16 |
| 3- | Electrical machines | 9.27 |
| 4- | Fabricated metal products | 2.24 |
| 5- | Metal structures products | 2.24 |
| Total production of intermediate consumption sector | | 93.06 |
| Total production of the components of final demand sector | | 6.94 |
| Sum of the total production | | 100 |

Occupied the industry, iron and steel industry (consumer of its production) ranked first among the sectors that sector consumes iron and steel industry outputs increased by 34.33%, while the sector was trade in second place with 5.06%, and the sector of refined petroleum products in third place by 2.63% (Department of statistics 2006).

Show input and output tables in general distribution of intermediate consumption for all sectors of the economy, whether self (i.e., the production sector consumes itself) or consumed for the production of other economic sectors.

Table (2-2)* Intermediate consumption sector, local iron and steel industry

| Num | Economic sector | Usage percentile % |
|---|---|---|
| 1- | Iron and Steel | 34.33 |
| 2- | Commerce | 5.06 |
| 3- | Refined petroleum products | 2.63 |
| 4- | Land escape transportation | 2.6 |
| 5- | Electricity | 2.15 |
| Total intermediate consumption for domestic sector | | 51.27 |
| Total intermediate consumption sector importer | | 48.73 |
| Sum of the total production | | 100 |

## 2-4 Overviews of Iron and Steel corporations in Jordan

### 2-4-1 Jordanian Iron and Steel corporations

The number of Iron and Steel corporations in Jordan is about 14 Steelmakers (Amman Chamber of Industry, 2013; Zarqa Chamber of Industry, 2013), the competition within Iron and Steel Organizations has been subjected to dynamic changes, the rivalry between these manufacturers within the External and Internal environment was uncertain with respect to many societal and industrial forces along with internal prospective, the Iron and Steel organizational manufacturing strategies has been transformed within recent 10 years, the following graphs (figure 2-7) will show how the market share within Steel organizations has been differed with over the period between 2001 and 2007.

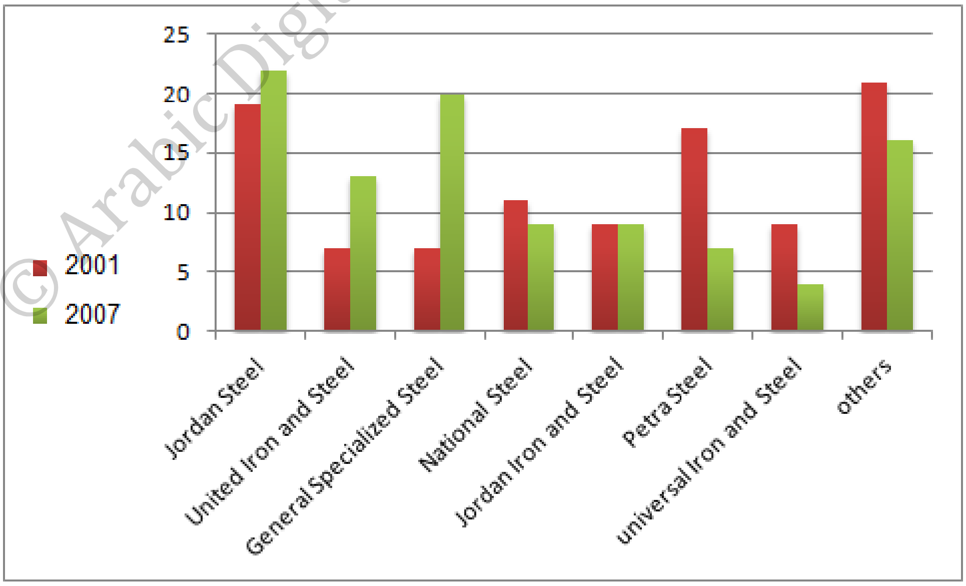



Figure (2-7) Steel Companies Market shares changes between 2001-2007 (Export and Finance Bank, 2002; Zawya & Global Research, 2009)

The rules of the competition within the Iron and Steel industry has been changed, while many steel organization found substantial growth in the market share claimed by pursuing cost-leadership (Middle East Steel Supplement, 2012), others found themselves out of the competition indicated by decline on their market share presented in figure (2-8) where others entered the market, this provoke the researcher to propose a useful technique helps Jordanian steel companies' superintendents and decision makers to articulate well-engineered plan of actions for their manufacturing strategies in order to survive.

### 2-4-2 Product Mix for Iron and Steel corporations in Jordan

Our major focus in this project is at the Jordanian Iron and Steel corporations which manufacture the concrete reinforcement steel bars or simply Rebars produced by roll mill, hence recently they manufacture variety of steel products that are designed to meet primary domestic and provincial market needs. Most of its products fall into two categories at the moment as follows:

**Concrete Reinforcement Steel Bars (Rebars):**

Reinforcing Steel bar, also known as Rebar, is a common steel bar (see figure 2-10), and is widely used as a tensioning bolster in reinforced concrete and reinforced masonry structures holding the concrete in compression. In Jordan most of the production of steel bars for construction (Rebars) includes all standard diameters between “8” mm and “32” mm in lengths of “6” or “12” meters. Sometimes Shorter and Longer Lengths are also manufactured if the corporations pursue make to order as production environment. Rebars are available in accordance with, Jordanian Standard (JSS) (Grade “300”, “420”,

"460" and "520"), ASTM 615 (Grade "40", "60" and "75"), BS 4449:97 (Grade"250" and "460") standards, and may also be produced to other international standards if the company have metallurgy lab and quenching technique.



Figure (2-8) Concrete Reinforcement Steel Bars made by Jordanian Iron and Steel corporations (Jordan Steel plc, 2013)

**Flat & Square Bars Section:**

The production of Flat/Square sections currently categories into the following sizes are produced:

1- Standard Flat Bars where the width in mm starts from 15 to 50, thickness in mm from 50 to 10, and length in m are from 4 to 6.

2- Standard Square Bars where this size dimensions are between 10mm² up to 20mm².

3- Plane round Bars where the verities of dimensions for the size are 10mm² up to 32mm², and length restrict between 6m up or 12m.

4- Some of Jordan Steel manufacturers fabricate other products following different strategic integration; for example, some of Jordanian Steel corporations are continuously expanding its product line, In addition some manufacturers introduce recently Wire mesh with different sizes seeking downstream strategic integration, while others and producing steel billets following upstream strategic integration.

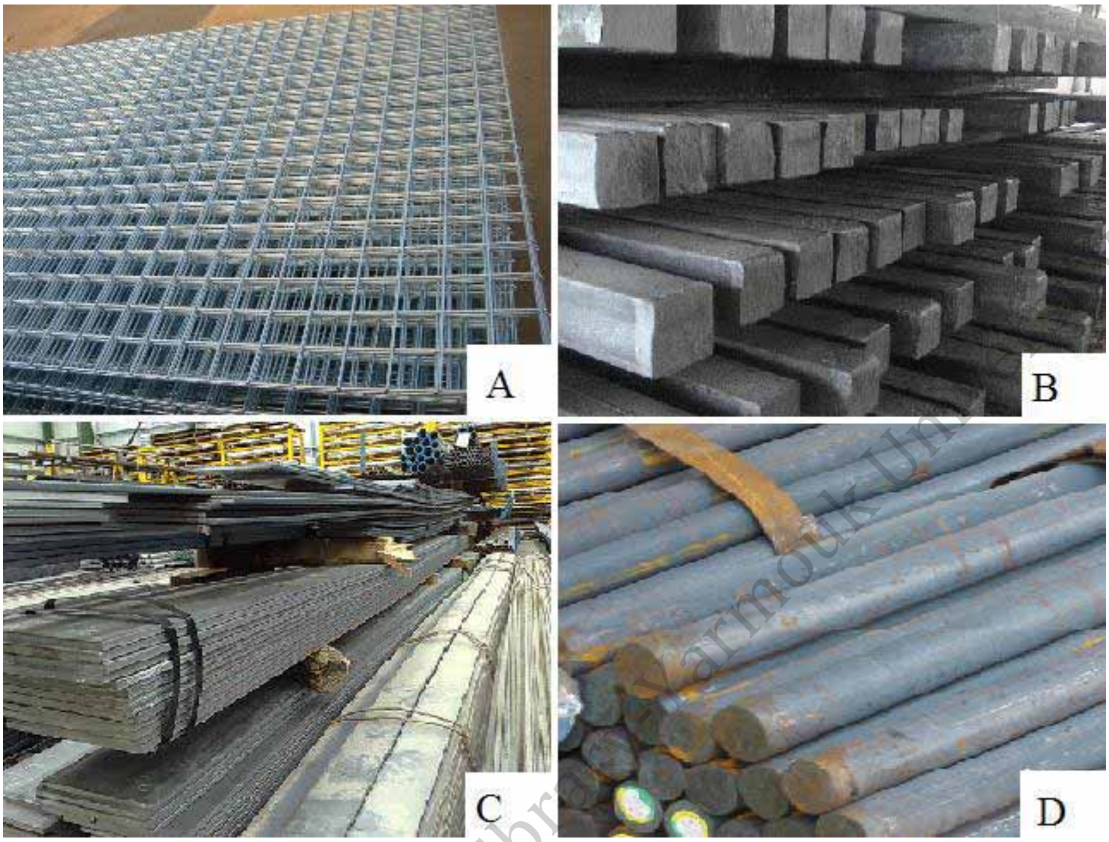



Figure (2-9) different Steel products made by Jordanian Steel corporations; (A) wire mesh, (B) Steel Billets, (C) Standard Flat Bars, (D) Plane round Bars; (Jordan Steel plc, 2013)



### 2-4-3 Iron and Steel manufacturing Technology in Jordan

The Main manufacturing Process technology used by Iron and Steel manufacturers to fabricate Steel Rebars products is the Hot Rolling Process; most material is transported out of the mill area by an automated coil handling system. The process includes 8 stages which are: Reheating, Descaling, Roughing, Edging, Descaling, Cropping, Finishing, and Laminar Cooling (Kalpakjian and Schmid, 2011).

Other manufacturing processes utilized in Jordan such forming the upstream integration with rolling process is the Scrap steel recycling, as

much of the scrap steel used is waste from the production process or expired metallic products. In Jordan ferrous scrap is also purchased from scrap metal dealers. The scrap steel is sorted into different grades according to In Jordan to the common two types which are the heavy and the light Steel scrap.

This followed by melting the Scrap steel using the electric arc furnace, the operation of producing batches of molten steel known "heats". The electric arc furnace operating cycle is called the tap-to-tap cycle and is made up of the following operations: Furnace charging, Melting, Refining, De-slagging, Tapping, Furnace turn-around end up with production of Steel billet which is the main raw material for Steel Rebars production process.



Figure (2-10) The Hot Rolling Process used by Steelmakers (Tata Industries, 2012)

## 2-5 The Challenges of Iron and Steel industries in MENA

Steel industry in the Middle East and North Africa has face many various challenges due to global crises 2008; Steel prices went up by almost 375 USD per ton during the first quarter in 2008 (Middle East Steel, 2008), Oil prices crossed the mark of 100 USD per barrel (Middle East Steel, 2008), oil demand increased by 9.55 % in China and 6.9% in India in the year 2007 (Middle East Steel, 2008), Raw material prices increased by 80 to 100% (Middle East Steel, 2008), the effects Steel producers initiated upstream expansion programs despite some Iron and Steel corporations slowed down of the projects (e.g. Emirates Steel delayed its second phase expansion plan, Emirate Steel insight, 2008), this is also affected within the local Iron and Steel corporations practices to adopt new manufacturing strategies. Jordan Steel corporations ranked in the middle between Middle Eastern and North African steel manufacturers.

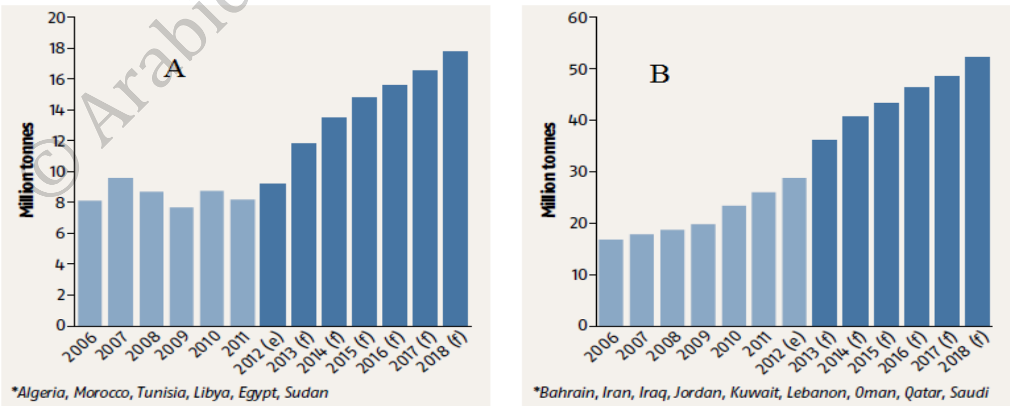



Figure (2-11) Total production of crude steel with (A) North Africa, and (B) Middle East; e: Estimated production, f: Forecasted Production (Middle East Steel, 2012)

## 2-6 Summary

In conclusion Jordan as Middle Eastern and South African country has many challenges and potentials, due to its limited resource the developing country Jordan achieved many economical deliverables according to its provincial countries with these insufficient funds.

While many observers consider the Jordan oriented towards to service economic, Jordanian Industry still too considered to the foundations of its economics, manufacturing industries in general and Iron and Steel sector in particular faced many environmental changes and difficult constrains due to periods between 2008 and 2012, the Iron and Steel corporations need to enact with these dynamic forces and adopt new manufacturing strategies to be able to survive and hopefully to achieve superior performance among its competitors.

Accordingly, some of Iron and Steel corporations seek new technologies and move forward to expand their facilities in order to achieve new capabilities, where others tried to execute downstream and upstream integration strategies as results for realized decision actions, aiming to enhance their performance and their position on the domestic and provincial market. Regarding to this, the next chapter is the foundation for such manufacturing strategies that formulated and concluded with different operational strategies done by previous researches that realized to construct the taxonomies of manufacturing strategies.

# Chapter 3

## The Taxonomies of Manufacturing Strategies

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# The Taxonomies of Manufacturing Strategies

## 3-1 Introduction

The purpose of this chapter is to understand the concept of operations strategy, and how configurations strategy is derived from this concept, then to realize how the two approaches of configurations strategy works: the typology of operational strategy in general and the taxonomies of operational strategy in particular. Starting from conducting with the previous studies by identifying their significant optimal taxons, then the project shows the interested sectors and their sample characteristics within each previous study within the attached indices.

Moreover, this chapter presents the methodologies used within the precedent literature to conclude their strategic aims and objectives. The variables are discussed and criticized, and the patterns of taxonomies are introduced, then this chapter represents the contributions made by this research to overcome the gaps within the previous studies.

## 3-2 The Configurations of Operations Strategy

While the beginnings was initiated by skinner (1969) when he mentioned the importance of a strategic alignment of the manufacturing function, followed by Porter (1980) in his text competitive strategy, he emphasized that strategic groups are formed in a different clusters, where are following same or similar strategies

along strategic dimensions and denotes that provides a reference framework between observing the industry as a whole and considering each firm individually, contemporary the operations strategy has received significant attention among researchers, specialists, and superintendents from the strategic operations management field, starting from the concepts of configurations of operations strategy, through the ideal classifications studies conducted by typologies of operations strategy, ending with empirical categorizations studies realized by taxonomies of operations strategy.

. Hence, one of most strategic research interests subjects is the configuration of strategy, where variety prospective for configurations was developed by many researchers (such as: Miles and Snow, 1978; Porter, 1980; Mintzberg and Water, 1985). Eventually, configuration strategy is defined as a group of organizations that tried to imitate each other based upon some logical subset of variables (Meyer *et al*., 1993), later Bozarth and McDermott (1998) concluded that the characteristic of configuration are distinguished by the multi dimensional profiles used to describe organizational, strategy, or process types.



### 3-2-1 The approaches of configurations strategies:

Strategy configurations were developed using two approaches, according to Miller (1996) they are: the approach of typology and the approach of taxonomy, the typology and taxonomy used as substitution to each of other in many relevant literature, but there were different in reality (Doty and Glick ,1994); the typologies were introduced as the ideal types each of which represents a peerless arrangement of organizational attributes that are believed to determine the relevant outcomes, on the other hand, the definition for the taxonomies as an empirical classification of mutually exclusive and exhaustive groups by using methods of numerical taxonomy

and an assortment of clustering algorithms and hypotheses testing technique to identify the mutual clusters in the data (Miller, 1996).

Many discussions made a comparisons between the typology approach and taxonomy approach, an introduction with more restricted approach using facts (Bozarth and McDermott, 1998), as well the classification variables are chosen according to presented literature and current task, hopefully to find that if the proposed groups are stable across techniques and sample data, and to find if a greater alignment between an organization and defined ideal types results in greater organizational performance.

### 3-2-2 The typologies of operations strategies

The Webster's dictionary defines typologies as a study or systematic classification of types that have characteristics or traits in common, in the same sense the typologies of operations strategies can be defined as ideal conceptual model which was constructed as a method of distinguishing strategic groups, most of practical applications tries to avoid configurations using typologies, many empirical studies typologies of operations strategies (such as Kotha and Orne, 1989) , where their paper suggests a conceptual framework that links manufacturing to business unit strategy and focuses on developing the concept of 'generic manufacturing strategies' at the strategic business unit (SBU) level. Including three variables referred to the structural decisions of manufacturing strategy: the process structure, the product line complexity, and the organizational scope. other framework presented (Ward *et al.*, 1996), the interrelationship between competitive strategy which was classified to niche differentiator was identified (Ward *et al.*, 1996), broad differentiator, cost leader, and lean competitor, and manufacturing strategy which was discussed from the content overview which includes the manufacturing capabilities or the realized

priorities, which included within in four dimensions: cost, quality, delivery, and flexibility, and manufacturing decisions areas which includes: the process technology, capacity, facility, and vertical integration, quality system, production planning, inventory management systems, work force management, manufacturing organization, a well interlinked between these dimensions will lead to better organizational performance, the previous typologies studies construct a solid foundations for the taxonomies of operations strategies which will be discussed on the following section.

## 3-3 The taxonomies of operations strategy

Skinner (1969) emphasize about the missing link between manufacturing and corporate success, his research towards the interested researchers and pragmatic observers to point at the manufacturing decisions or choices within each type, where the researchers start to find the milestone effects performance of operations strategy as concluded (Zhao *et al.*, 2006; Ketchen *et al.*, 1996) find out taxonomies are especially valuable for initially classification before subsequent analysis such as comparative studies, in construct there are other classification models as epitomized (such as Bozarth and McDermott, 1998; Kathuria, 2000) in the manufacturing strategy, and for service operations strategy (Menor *et al.*, 2001).

(**Note**: the details about the previous studies are located in Appendix A).

### 3-3-1 The variables of the taxonomies of operations strategy:

Strategy literature represents many different approach to conducted with different variables to construct the taxonomies of operations strategies as discussed (Miller and Roth, 1994); for example the attributes of the firm in term of environment or

technology with noting to structure as mediator variable, or in term of creativity and innovations (Burns and Stalker, 1961), other researchers attempt to categories firms in terms of decisions actions and strategic integration (Huete and Roth, 1988), others were focused within the same business or same industry (Bülbül, 2011).

Accordingly, the most common variable used to indicate the taxons of operations strategy are the competitive priorities or capabilities, which adopted by many research of manufacturing strategy (e.g. Miller and Roth, 1994; Kathuria, 2000; Frohlich and Dixon, 2001; Sum et al. 2004; Zhao *et al.*, 2006), also used by the researchers of service operations strategy (e.g. Menor *et al.*, 2001).

The Competitive Manufacturing Capabilities utilized by the researchers (e.g. Kathoria, 2000; Menor, 2001; Sum *et al.*, 2001) includes; cost, quality, delivery, and flexibility, some used broader definitions for competitive capabilities by adding after sales service, broadness of distribution and product line (e.g. Miller and Roth, 1994; Frohlich and Dixon, 2001).

The researcher of operations taxonomies attributed the competitive capabilities according to three different viewpoints; the first is viewed as the relative importance attributed to each capability alone or compounded with each of other such as studies (e.g. Miller and Roth, 1994; Kathoria, 2000; Frohlich and Dixon, 2001; and Zhao *et al.*, 2006).

The second attribution related to decisions in manufacturing, since first introducing the concept of decision categories which will impact the operations strategy classifications (Hayes and Wheelwright, 1984), provide A summary of a number of decision category frameworks in the literature and find that the division of categories into structural and infrastructural categories (Rudberg and Olhager, 2003).

The third attribution was related to empirical performance of competitive capabilities in comparison to other competitors which presented in many studies (e.g. Menor *et al*., 2001; Sum *et al*. 2001), A concluded that the choice of taxons in a taxonomy studies depends on what the researcher intended to accomplish if the researcher intended to identify the strategies only (Miller and Roth, 1994), then the taxonomies should be constructed based on the emphasis or importance places on competitive capabilities, but if the taxonomy is to be used to explain the performance, then strength in competitive capabilities might be a more viable alternative.

Recently researchers adopted an towards to new prospective for the taxonomies of operations strategy; A views for the taxonomy of operations strategy as a roadmap of the relationship between the building blocks of operations strategy; the core competencies (Lowson, 2003), capabilities and processes, resources, technologies and key tactical activities that are pivotal to support a particular strategic niche.

### 3-3-2 The previous models of taxonomies of operations strategy

The literature introduces various number of developed taxonomies of operations strategy relative to the different combinations of operations strategy capabilities of cost, quality, delivery, flexibility, and after sales service, for example: Miller and Roth (1994) categorizes the respondents to three strategic groups; Cartakers, Marketers and innovators, many researchers follower Miller and Roth (1994) and tries to imitate their studies by manipulating the population and the sample (e.g. Frohlich and Dixon ;2001; Sum *et al.*, 2004) identified anther three clusters which are; All rounder, Efficient innovators, and differentiators.

Moreover, Kothoria (2000) identified four cluster groups which are; starters, efficient conformers, speed conformers and do all, Menor *et al*. (2001) developed four clusters too; Agile, Traditional, Niche and Straddlers, Zhao *et al*. (2006) developed four clusters; Low emphasizer, quality customization, Mass server and Specialized contractor, Frohlich and Dixon (2001) expanded Miller and Roth (1994) three taxons to six taxonomies; which are Cartakers, Marketers, Innovators, Idlers, Servers, and Mass customization.

In construct, concerns on service operations taxonomies was come to the surface, nowadays the taxonomies of service operations strategies is the researchers interest focus, researcher (e.g. Aranda, 2002) which introduced operational service taxonomies which includes the following dimensions; these dimensions represents process related capabilities, information technology related capabilities, work force related capabilities, and design related capabilities, these dimensions are; Push and pull oriented of the service delivery process, back office and front office activities relationship, degree of customer participation, use of information technology, human resource specialization, new service design and development and number of different service offered, Aranda (2002) developed three clusters of service operations strategy; process oriented, customer oriented, and service oriented.



***Low emphasizes oriented taxonomies***

This classification includes Caretakers cluster which introduced by Miller and Roth (1994), All rounder of Sum et al. (2004), Low emphasis of Zhao et al. (2006), Starters of Kothoria (2000), Straddlers of Menor et al. (2001), and process oriented of Aranda (2002).

This cluster is characterized by a low relative emphasis on the different competitive priorities adopted by all clusters, so this cluster may has a low

distinctive operational advantage over other clusters, the Caretaker is the highest relative emphasis among all cluster on cost but not significant, for all rounder the top performing capabilities in the cluster are; quality conformance and quality performance, but for starter the quality and cost, and for Straddle is the cost.

Process oriented of Aranda (2002) has the following characteristics; sequential push process oriented, most activities are standardized, the back and front office activities are physically separated, low customer contact, highly specialized workforce, the new technologies was developed to reduce cost, the design and development of new services is not highly supported, and range of different services offered is short and services are closely related, so the majority of the clusters of this category focus on cost.

***Agile oriented taxonomies***

It is the same as Mass server of Zhao et al. (2006), Do all of Kathuria (2000), and Agile of Menor et al. (2001); these clusters reported relative strongest emphasis on all competitive capabilities among the clusters developed.

***Customer centric taxonomies (differentiator)***

This cluster includes the Marketer of Miller and Roth (1994) which they called like this because they seek to obtain broad distribution, to offer broad product lines, and to be responsiveness to changing volume requirements, conformance to quality, dependable delivers, and product performance, Traditional group of Menor et al. (2001); which have the highest relative emphasis on quality and delivery among the competitive capabilities of the cluster.

Also the Differentiators of Sum et al (2004) which distinguished in their high relative emphasis among all clusters on quality conformance, the Quality customization of Zhao et al. (2006) which has the highest quality rank within cluster and second highest statistically across all clusters also the design flexibility was ranked the second among the capabilities of this cluster.

The customer oriented of Aranda (2002) is related to this cluster, the operation process is pull oriented highly customized, back and front office activities are physically integrated, with high customer contact with process, the employees are trained for veracity, anybody must be able to develop any task totally or partially, the technology used to increase customer satisfaction, continuous development of new services, and the differentiation of services provided is high.

***Innovation oriented taxonomies***

Innovators of Miller and Roth (1994) which have a high relative emphasized in comparison with other clusters on making change in products design and introduce new product quickly, and Efficient innovators of Sum et al. (2004); which Distinguished in their high relative emphasis among all clusters on cost, delivery and flexibility.

***Efficient conformer oriented***

The same efficient conformers of Kathoria (2000), which have a High relative emphasis on cost and quality among all clusters, Niche group of Menor et al. (2001), which have The high relative emphasis on quality and cost among the cluster competitive capabilities, and service oriented of Aranda (2002), which has a hybrid process layout pull oriented with low capacity, back office and front office are

separated but share personnel, different closely related services offered, low intensity of new product development, highly specialized personnel trained for variety tasks, the new technology is used to balance both cost reduction and customization.

***Lean oriented operations strategy***

Specialized contractors of Zhao et al. (2006) which have the highest relative emphasis among all clusters on speed, cost and performance of quality, whereas conformance to quality was ranked second, and speed conformers of Kathuria (2000); which emphasized on the speed among the cluster competitive priorities.

Lowson (2001) listed the following taxonomies of operations strategies of retail stores, these taxonomies are; quick response (QS), efficient customer response (ECR), time based competition (TBC), supply network strategy, JIT and JIT II, agility in the supply system, strategic outsourcing, and world class manufacturing, the organization could adopt one or more of these operations strategies as founded by Lowson (2001) in retail industry.

Some researcher decided to identify the operations choices related to each taxonomies of operations strategy; Miller and Roth (1994) decided to identify the choices in term of programs adopted related to different taxonomies of manufacturing strategies; the Caretakers adopted labor management relations, zero defects, SPC process, SPC product, and reducing workforce size, innovator more associated with MFG lead time reduction, CAD, new product of process development.

Sum et al. (2004) found that efficient innovators were distinguished by adopting JIT systems, increasing automation and mechanization and employing

better forecasting systems, but differentiators were distinguished in ontaining ISO 9000, but all rounder did not distinguished in adopting any program.

Menor et al. (2001) decided to identify the different resources competencies adopted by each cluster, and different choices, the agile more adopt the technology leadership, work force knowledge, and market acuity competencies than other taxonomies, also there are differences in choices adopted in term of flexible service capacity expansion, work force flexibility and the integrated technologies adopted.

Lowson (2001) found that each taxon of operations strategy adopted different combination of process capability, network capability, and used different resources, technologies and adopted different tactics.

### 3-3-3 The context of operations strategy taxonomies

Many researchers believe taxonomies studies goes by the formulation of a numerical taxonomy and clusters algorithms, Miller and Roth (1994) goes beyond that by attempting to identify the construct that underline its formation and by observing the apparent relationship between group membership, business context, manufacturing choices and manufacturing performance measures.

Accordingly, related to manufacturing prospective, Miller and Roth (1994) noticed that the taxonomies react differently according to the sectors' industries, for example; the electronics and machinery industries more adopted the innovator taxonomy, while the basic industries more adopted marketer, and caretaker was more adopted by consumer packaged goods.

Moreover, Frohlich and Dixon (2001) continuous the taxonomies developed by Miller and Roth (1994) in North America and expand the sample to include South America, Western Europe and Asia Pacific, and introduce as well as new

taxons, the Caretaker and Innovators were implemented according to study in South America, West Europe and Asia Pacific, but there are also at least three types adopted around the world; Idlers, Servers, and mass customization, so conclusion is that there is seem to be some underlying differences perhaps due to demographic variables between manufacturers in different location of the emerging global economy.

On the other hand, for service view, Lowson et al. (2001) reach to conclude that different retail stores use different combinations of taxonomies; the fashion more toward at quick customer correspondence, grocery stores more adopted of efficient consumer response. Lowson (2002) emphasized that different group of service operations strategy could be developed according to the degree they offer variety and the volume of service provided; which are; standardized service operations strategy, assemble to order and customized service operations strategy.

## 3-4 The performance of operations strategy taxonomies

The performance is a key word in business world can be defined in many different terms, where there is no standard to indicate the performance, in construct, performance is a measure for multi dimensional indicators; marketing, financial, or operational to assess the efficiency and the effectiveness of each strategic group, previous taxonomies of operations strategy used different performance indicators to identify the best taxons options can be chosen for strategic group.

The taxonomies of operations strategy was assess by the performance in the most of previous studies; the preponderance studies favored self reporting performance measure also the other variables was indicated by using the same method; Miller and Roth (1994) used a non financial relative performance in term of

manufacturing lead time, set up time, headcount, ratio of blue/white color employees, outgoing quality, number of grievances, and % of new product development.

While Kathoria (2000) decided to use non financial to assess the managerial performance of manufacturing unit by using indicators such as; quality of work, accuracy of work, productivity of the manufacturing group, customer satisfaction, operations efficiency, quality of the work and timeliness in meeting delivery schedule.

Sum et al. (2004) adopted a classical relative to the self reporting financial performance in comparison to the competitors; overall financial performance, growth in annual sales, growth in market sales, return on sales (ROS), return on investment (ROI), growth in investment.

Recent researchers adopted view Menor et al. (2001), where he also used a non financial performance indicator which was includes; business sustainability, quality of customer interface and factor productivity, and financial performance indictors in term of; total assets, return on assets.

Most importantly, some researchers found out there is significant differences in performance between strategic groups; such as Miller and Roth (1994), Kathoria (2000), Menor et al. (2001), and Sum et al. (2004), while others such as Zhao et al. (2006) did not find such significant differences.

## 3-5 Summary

In conclusion, the number of taxonomies developed is between three to six, accordingly, the number is affected by the size of sample as seen the research by Miller and Roth (1994) included three taxons followed by Frohlich and Dixon (2001) which reaches six taxons due to expand sample, also the titles provided to each cluster reflects the combination of competitive capabilities of each cluster, some of the clusters developed by different researchers share the same capabilities but the titles are different, also some taxonomies developed for manufacturing strategies such as Miller and Roth (1994), Kathoria (2000), Frohlich and Dixon (2001), Sum *et al*. (2004), and Zhao *et al*. (2006), but Menor *et al*. (2001), Aranda (2002), and Lowson (2001) developed Taxonomies for service sector, but can be contained in certain directions reflects it main impact on the industry or service.

Also some researchers found out performance indicators have significant influence effects in clustering the strategic groups, study of Sum *et al*. (2004) where found All rounder did not receive significant performance measures, but efficient innovator differentiated in overall financial performance, growth in annual sales and growth in market sales, also Menor et al. (2001) found that the agile group assigned with high performance among all groups.

But the major drawback of previous taxonomies of operations strategies they were mostly using snapshot self-reporting methodology to indicate the competitive capabilities or performance indicators except Bozarth and McDermott (1998) were used facts to reflects their study variables, which has two disadvantages; it can be considered to be objective because it reviewed according to issued, also it can't grantee the homogeneity between them because every organization has unique organizational chart, employee titles, and employee

specialization so the demographic factors will be influence the study variables which considered extraneous factors could contaminate the research aims and objectives.

Moreover, the self snapshot self-reporting methodology will answer a tentative answer to research question, but for future prospective this methodology will not give the industrial organizations the opportunities to ameliorate their position or to select new competitive capability by making new decision actions, or to find the critical capabilities or decision actions that emerged and causing superior performance.

In that sense the research will use facts and quantitative data which should give the researcher the chance to indicate the competitive capabilities, decision actions, and performance indictors more objectively. In addition, previous taxonomies followed Porter (1991b) prospective were he drew attention to the need of understanding both the cross-sectional problem in strategy (the causes of superior performance at a given point in time) which solved through self-reporting methodology, but contemporary strategic researches aim to the longitudinal problem (the dynamic process by which strategies are arrived at), following Mintzberg's contributions have tended to focus on the longitudinal rather than the cross-sectional problem. Whereas Mintzberg's view of strategy is more process-focused (how strategies are arrived at over time in organizations), position in terms of particular organizational arrangements). The research will introduce the **tentative**, **sustained** and **emergent** taxonomies of operations strategies, where the tentative exams the taxonomies over the research time frame, on the other hand sustained taxonomy will be indicated by the average of capabilities practiced over the research period, and the emergent taxonomies used the maximum percentage difference over the past five years. The next chapter is the roadmap for the research project, which showed how to achieve the research objectives, and eventually will allow us to answer the research questions according to **tentative**, **sustained** and **emerged** definitions.

# Chapter 4

## Research Methodologies

Chapter 4

# Research Methodologies

## 4-1 Introduction

This chapter seeks to identify the research methodologies and methods used to achieve the research aims and objectives, which are differentiated from the research question. This chapter discusses in depth how to answer the research question according to **tentative**, **sustained** and **emerged** definitions.

The chapter presents phases of this project, it shows how to realize each objective alone, and then it integrates these objectives to answer the research question.

## 4-2 Thesis Aim, Objectives and Question

### Aims

The project aims to identify the Taxonomies of the Jordanian Iron and Steel corporations manufacturing strategies over the period 2008-2012.

### Objectives

1. Using literature to operationally define the operational capabilities, actions, and performance indicators of the Iron and Steel corporations.

2. Constructing the conceptual Model for Iron and Steel Manufacturing Strategies.

3. Identifying the operational capabilities, actions and performance indicators adopted by the Iron and Steel corporations in Jordan over the period (2008-2012).
4. Identifying the taxonomies of Iron and Steel corporations manufacturing strategies according to **tentative**, **sustained** and **emerged** operational capabilities in Jordan over the period (2008-2012).

5. Identifying the significant actions made by the Jordanian Steelmakers to realize the taxonomies of manufacturing strategies by the Iron and Steel organizations in Jordan over the period (2008-2012).

6. Identifying the significant performance achieved by the Jordanian Steelmakers through realizing the taxonomies of manufacturing strategies for the Iron and Steel organizations in Jordan over the period (2008-2012).

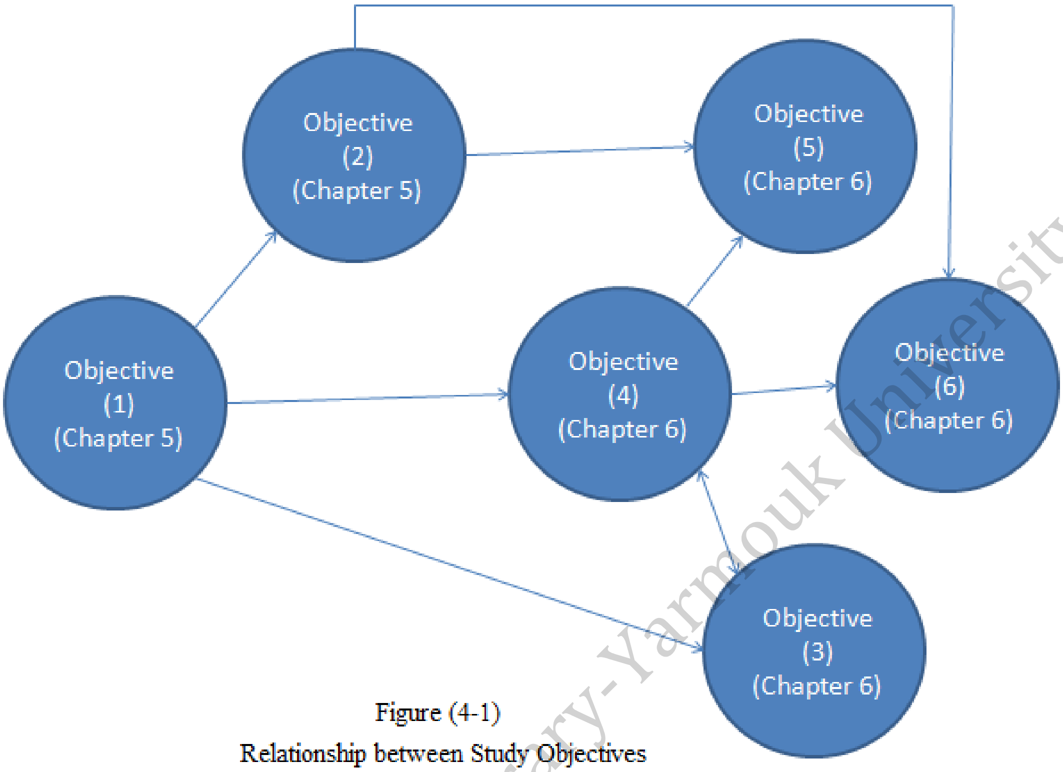



Figure (4-1)
Relationship between Study Objectives



The relationships between the research objectives are shown in figure (4-1), the realization of research objectives are started at chapter 5 where the research variables (including manufacturing capabilities, actions, and performance indicators) are operationally defined according to previous studies and technical literatures, and the measurement of the manufacturing strategy variables are identified through this chapter, then, the second objective is realized through chapter 5, where it represents the conceptual model of Iron and Steel manufacturing strategies is presented. This model is developed by using literature review and secondary literature.

Next, new scales methodology are developed to indicate the relative performance for each variable; this allowed the researcher to identify the operational capabilities, actions and performance indicators adopted by the Iron and Steel

corporations in Jordan over the period (2008-2012), so the third objective is realized.

To realize the fourth objective the Iron and Steel corporations in Jordan are clustered into manufacturing strategic groups. the manufacturing strategic groups are identified by the manufacturing capabilities using the K-means cluster analysis. This phase is classified into three sub-phases; the first part will include the tentative taxonomies are identified, then the research will determine the sustained taxonomies, finally the emerged taxons determined, each taxons are determined according it s definitions.

Next, the research identifies the relative significant actions to taxons to achieve the fifth objective, and then the research evaluates the performance achieved through realizing the taxonomies of manufacturing strategies for the Iron and Steel to achieve the sixth objective.

## Research Question

What are the **Tentative**, **Sustained** and **Emergent** Taxonomies of Manufacturing Strategies adopted by Iron and Steel Organizations in Jordan?

After achieving the previous research objectives, this led to the answer of the research question. In the following part of this chapter both data-collections and data analyses are elucidated.

## 4-3 Answering the Research Question

The research passed seven phases. Phase I sets the research problem by identifying the study variables (competitive capabilities, actions, and performance indicators), the operational definitions within the context of Iron and Steel manufacturing are mentioned. The Phase II used the secondary literature of the content of operations strategy to identify the relationship between the manufacturing strategy variables: (manufacturing capabilities, decision actions, and performance indicators), then the Iron and Steel industry conceptual model is differentiated according to these relationships in this phase.

The outcomes of Phase I and II are the main inputs to Phase III, over this phase the data is collected, and then the collected data transformed it into relative scale. The outcome of this phase is the facts related the manufacturing capabilities, actions and performance indicators adopted by the Iron and Steel corporations in Jordan over the period (2008-2012).

Over Phase IV the manufacturing variables are rated by using a special scale technique (SDRM) which depends on the mean and the standard deviation of the study variables. The research presents Jordanian Iron and Steel industry general characteristics statistics within the study period.

The Phase V considers being the milestone phase for the research project, where the taxonomies of Iron and Steel corporations manufacturing strategy are determined, in accordance to **tentative**, **sustained**, and **emerged** definitions, (**K-mean**) cluster analysis the optimal categories with maximum significant competitive capabilities is chosen separately for each definition.

The phase VI identified the significant decision action taken and the performance indicators achieved by taxons of the Jordanian Iron and Steel corporations as a result of cluster analysis; this phase will help the decision-makers to choose the best action to gain or exceed generic strategy resulted by clustered taxons, as well as, to outperform their competitors.

Finally, in Phase VII the taxonomies of manufacturing strategies were determined, and then a roadmap for the generic strategy for each cluster is realized. Where each taxon includes: competitive capabilities, actions, and performance indicators were developed. In that sense the process decision-maker and the production manager will have the tactics to maneuver according to tentative definitions, and the directors, observers and strategist will have better understanding for the realized taxon according to sustained and emerged definitions.

### 4-3-1 Phase I: Achieving the First Objective

**O1: Using literature to operationally define the operational capabilities, actions, and performance indicators of the Iron and Steel corporations**

The literature review establishes the foundation for the research project, firstly by introducing the configuration strategies types: typologies and taxonomies of operations strategies. Then the research main variables and its components are introduced in accordance to the Iron and Steel industry technical terms' and the manufacturing strategies previous literature.

Thus a clear list of Iron and Steel manufacturing capabilities, actions and performance indicators is identified. Identifying the elements for each variable is important since the taxonomies for Iron and Steel manufacturing strategy in particular never been covered by the previous studies according the researcher best knowledge. The procedure used to achieve this objective is as follows.

**1:** the main variables of manufacturing strategy were identified by reviewing the literature of manufacturing strategy formation. According to this literature the main variables are the manufacturing capabilities, decision actions, and performance indicators.

**2:** identifying the items for each main variable. The literature on manufacturing strategy content formation was revised. The (competitive priorities) manufacturing capabilities includes: (cost, quality conformance, quality performance, delivery reliability, delivery speed, product mix, and

volume flexibility), decision actions components are: (capacity utilization, vertical integrated supply chain, Location, and facility layout design), and performance indicators presented by: (relative market share, sales growth, return on asset, return on sales, and overall performance indicators).

**3:** Identifying the definition and measures of each specific capability, action and performance indicators in the context of the Iron and Steel industry. Where the chapter 5 provide the operational definitions supported by the background chapter 2 which provides the technical terms.

### 4-3-2 Phase 2: Achieving the Second Objectives

### O2: Using Literature to construct the conceptual Model for Iron and Steel Manufacturing Strategies.

After defining the research variables and its measurement, using secondary literature the research constructs the relationship between the manufacturing capabilities and the decision have been made by the Iron and Steel corporations, also the relationship between the manufacturing capabilities with the overall firms' performance is determined. Then the patterns of taxonomies for manufacturing strategies is emerged along with either the actions have been made or the performance achieved within the strategic categories. These relationships identify the conceptual model for Iron and Steel manufacturing strategy.

Taxonomies of manufacturing strategies were firstly introduced by Miller and Roth (1994), and followed by many researches that used self-reporting to indicate tentative taxons. The literature for taxonomies of operations strategy

covered both industrial sector (e.g. Miller and Roth, 1994, Kathoria, 2000, Frohlich and Dixon, 2001, Sum *et al*., 2004, and Zhao *et al*., 2006) and service sector (e.g. Menor *et al*., 2001, Aranda, 2002, and Lowson, 2001). Iron and Steel industry taxonomies were limited in their scope according to the researcher best knowledge.

The outcomes from Phase II are summarized as following:

**1:** previous studies in manufacturing strategies along with the Iron and Steel industry secondary literatures were revised to identify the relationship between the research variables.

**2:** the general taxonomies of Iron and Steel manufacturing strategy using literature were identified. A proposed Iron and Steel manufacturing strategy taxonomy according to **tentative**, **sustained** and **emerged** definitions were identified.

## 4-3-3 Phase 3: Data-Collection

After identifying the conceptual model, where the variables measurements are clearly identified and their interrelationships, this phase is started by determining the sample and the respondents, and then the time frame for the research is set. The secondary data-collection tool is developed, ending with justifying the validity and reliability for this project.

### 4-3-3-1 Identifying the Sample and Source of Data

The population includes all the Iron and Steel Rebars rolling mill manufacturers in Jordan, which consist of 14 Iron and Steel corporations; three Iron and Steel manufacturers are listed in the Amman Stock Exchange,

other Steelmakers are rated being limited liability or private companies (Amman Chamber of Industry, 2013, Zarqa Chamber of Industry, 2013). Although the population has small size, the researcher hoped to include the all the population, some of steelmakers has reservation to disclose their information, the sample included seven major Iron and Steel corporations. The sample covers about 80% of market share for Jordanian Steel Re-Bars market. These Steelmakers are indicated by: (A1, A2, A3, A4, A5, A6, and A7) to reserve there confidentiality.

**4-3-3-2 Identifying the Research Time Frame**

The time frame of this research was set at 5 years, from the year 2008 until the year 2012. During this period Jordan economics has been influenced by the global financial crisis of 2008 and what the local observers called the Jordanian recession in 2010. Many Jordanian Steelmakers emerged new strategy to enact with the external environment changes and hoped to survive where some of these corporations did and others unfortunately not.

**4-3-3-3 Data-Collection Instruments**

Since facts (including: quantitative data ,hardware information, and other statistics) were used, the main source for data were: Annual Sales/Marketing reports, Quality Performance certificate, conformity certificate, Financial Statements, Annual Reports, and other statistical reports. The data were gathered by the researcher himself via appointments with the seven steelmakers Executive Managers, Production Superintendents, Financial managers, marketing managers, and sales engineers.

The researcher briefed the data concerns the research project and filled out a customized form used for the purpose to collect of the facts. The forms are classified into five categories: Price information, Sales information, Quality Questionnaire, Financial information, and Inventory information. These customized forms are shown in appendix (S2).

#### 4-3-3-4 Identifying Source of Items and Sub-Scales of Each Instrument

The customized form items were determined from the literature. The measurements for the research variables are Quantitative and Categorical Data (nominal scale) see table (4-1), table (4-2) and table (4-3):

Quantitative: the main sub-scale measurements for most manufacturing capabilities, actions and performance indicators, since these are facts not a matter of opinion.

Nominal: some variables such as quality components, flexibility and the majority of decision actions are a matter of availability, and the steelmakers have the facts as option, but they are still facts so they were represented in a nominal scale.

Table (4-1) competitive capabilities components and its items sub-scale categories and unit of measurement

| **Variable Components** | **category** | **Measurement unit** |
|---|---|---|
| Cost | | |
| Price | Quantitative | JD |
| Operational Cost/Annual Sales | Quantitative | JD/Tons |
| Operational Revenue/Annual Sales | Quantitative | JD/Tons |
| Quality | | |
| Quality Conformance | Nominal | Yes/No |
| Quality Performance | Nominal | Yes/No |
| Delivery | | |
| Delivery Reliability | | |
| Contribution Margin | Quantitative | Ratio |
| Number of mark down | Quantitative | Ratio |
| Stock-Out Ratio | Quantitative | Ratio |
| Delivery Speed | | |
| Operating Cycle | Quantitative | Ratio |
| Inventory Turnover | Quantitative | Ratio |
| Flexibility | | |
| Product Mix | Nominal | Availability |
| Volume Flexibility | | |
| Sales Seasonality Index | Quantitative | Ratio |
| Price Seasonality Index | Quantitative | Ratio |

Table (4-2) Decision Action components sub-scale categories and unit of measurement

| Variable Components | category | Unit of measurement |
| --- | --- | --- |
| **Utilization** | Quantitative | Ratio |
| **Supply Chain Integration** | | |
| **Upstream Integration** | Nominal | Availability |
| **Downstream Integration** | Nominal | Availability |
| **Location** | Nominal | City |
| **Facility Design Layout** | Nominal | Option |

Table (4-3) Performance Indicators components sub-scale categories and unit of measurement

| Variable Components | category | Unit of measurement |
| --- | --- | --- |
| **Relative Market Share** | Quantitative | Percentage |
| **Sales Growth** | Quantitative | Percentage |
| **Return On Assets** | Quantitative | Percentage |
| **Return On Sales** | Quantitative | Percentage |
| **Overall Performance** | Quantitative | |

#### 4-3-3-5 Customized Form Layout

- **Cover Letter:** introduce in the first page of the forms and questionnaire, which provides the respondents with overview of the purpose of the research project and how to protect the Iron and Steel corporations' confidentiality statements.
- **Overview**: for each of five parts customized form has an introductory material included definitions and period classification, this overview includes also the purpose for each section of the format.
- **Form items**: five formats were made, which are:

  1- The Price form to present the average sales price for steel for each month within the past five years.

  2- Sales format includes both the quarter sales and the total annual sales achieved within the study time frame.

  3- Quality Questionnaire which includes the certificate awarded and the procedure for both quality performance and conformance with in the period of the study.

  4- Financial format which includes the financial measures (facts) were the research variables are derived from

  5- Inventory questionnaire and format which includes the product line made by the Steelmakers and the average stock statistics for the period 2008 to 2012.

**Price Form F1**

This include the Average price for Steel Rebar ASTM 615 grade 60 for each month with the Period of 2008-2012, since most steelmakers produce the medium Ferro-silicon-manganese alloy steel more than the light Ferro-silicon-manganese alloy steel and others which made by special orders, the Price lately will be processed to determine different variable items according to their operational definitions.

**Sales Form F2**

This Format includes the quarter and the annual sales for the past five years, most sales engineer, and executive confirmed to the researcher that the sales represents more than 80% of total seasonal and total production. In that since the sales will represent different manufacturing capabilities and actions components, in the same way the annual sales for each year will be used as pivotal factor to neutralize the effect of capacity and economic of scale for each corporation.

**Quality Questionnaire Q3**

A simple Questionnaire is used to confirm to both the Jordanian conformity standards (JSS), the American standards (ASTM), and the specialized standards to indicate the quality performance. Also the Questionnaire includes the conformance certificate awarded by the steelmakers over the research period (2008–2012).

**Financial Form F4**

This form includes the facts will be used to identify the manufacturing capabilities, and performance indicators within the period (2008-2012). These facts were used to calculate the manufacturing strategy variable related to competitive capabilities and performance indicators (*see appendix A*).

**Inventory Form F5 and Q5**

This form and questionnaire include the facts related to inventory performance to determine delivery speed, the stock-up ratio, and the product line-up offered by the Jordanian Steelmakers within the study period.

The forms and Questionnaire F1, F2, Q3, F4, F5, and Q5 are showed in the appendix, also a summary for each Iron and Steel corporations participated are presented within the appendix.

**4-3-3-6 Collecting Data related to manufacturing capabilities, Actions and Performance Indicators for the period 2008-2012**

The data related to manufacturing strategies were collected from seven Jordanian Steelmakers. The facts and quantitative data were collected from Sales reports, financial statements, annual reports, conformity and performance certificate and other statistical reports. The data was collected by the researcher, by personal visiting to the Jordanian steelmakers' plant and administrative offices included within the sample, where he has been given the chance to acquaintance the needed information. Later a special scale presented to compare the variable performance for the Iron and Steel corporations and maintain their confidentiality.

The Forms and Questionnaire used to collect the facts for the manufacturing strategies variables were: F1, F2, Q3, F4, F5 and Q5 see appendix (S2). The customized Form was developed by the researcher and the sources of items were determined from literature review and secondary literature, the measurements of variables are quantitative and nominal (see *table 4-1, table 4-2 and table 4-3*).

**O3: Identifying the operational capabilities, actions and performance indicators adopted by the Iron and Steel corporations in Jordan over the period (2008-2012).**

### 4-3-4 Phase IV: Identifying the variable for manufacturing strategy for the period 2008-2012

The research variables for manufacturing strategy for the period 2008-2012 are: the manufacturing capabilities which includes: (cost, quality conformance, quality performance, delivery reliability, delivery speed, product mix, and volume flexibility), decision actions components are: (capacity utilization, vertical integrated supply chain, Location, and facility layout design), and performance indicators presented by: (relative market share, sales growth, return on asset, return on sales, and overall performance indicators).

Using data collected from the forms F1, F2, Q3, F4, F5 and Q5 (*see appendix B*) with the formulas (see appendix A) which able the researcher to identify the variables for manufacturing strategy for the period 2008-2012, each variable will be represented later after scaling according to tentative, sustained and emerged definitions.

### 4-3-4-1 Identifying the manufacturing capabilities for the period 2008-2012

**Cost**

Table (4-4) shows the cost items are the price, operational cost per annual sales and operational revenue per annual sales according. Both operational cost and operational revenue are divided by the amount of sales on tons to eliminate the effect of capacity and economic of scale.

Table (4-4) Cost items formulas

| Item | Formula | Forms |
|---|---|---|
| **Price** | The Average Price for Each year | F1 |
| **operational cost per annual sales** | The annual operational cost divided by annual sales | F2 and F4 |
| **operational revenue per annual sales** | The annual operational revenue divided by annual sales | F2 and F4 |

**Quality conformance**

Table (4-5) shows the quality conformance items, the quality conformance items is determined by the quality program applied within the Steelmakers, if the companies have the certificate this will indicate the company have high rank regarding quality conformance, while if the company having the quality program, but not achieved the certificate the companies are performing below

the average, and if the company hasn't quality management program this will give it lowest score within a scale of 6 points (*see table 4-5*).

Table (4-5) Quality conformance Score estimated from Questionnaire Q3

| Aspects | Score |
|---|---|
| **ISO 9001:2008** | 6 points |
| **QMS W/O Certification** | 3 points |
| **No QMS is applied** | 1 points |

**Quality Performance**

Table (4-6) shows the quality performance items and its score, which is indicated by the Steelmakers conformity for the local Jordanian standards (JSS), conformity to the American standards (ASTM), and conformity to other standards or to the special orders, Steelmakers which have metallurgy labs, strength of materials labs and quenching process are able to confirm to any standards. If the companies have these techniques this will indicate the company have high rank regarding quality performance, for each standard the Steelmaker confirm it, it gained a score for it ranks in range of 6.

Table (4-6) Quality Performance Score estimated from Questionnaire Q3

| Aspects | Score |
|---|---|
| **Conformance to JSS standards** | 2 points |
| **Conformance to ASTM standards** | 2 points |
| **Conformance to other Standards** | 2 points |

**Delivery Reliability**

Table (4-7) show the items and formula of delivery reliability capability, the items according to supply chain model (Hausman, 1997) are: the contribution margin, the number of markdown, and stock-out ratio.

Table (4-7) Delivery Reliability items Formulas

| Item | Formula | Forms |
|---|---|---|
| **Contribution Margin** | Profitability per Total Sales | F4 |
| **Number of markdown** | Price Range per Average Price | F1 |
| **Stock-Out Ratio** | Stock Availability per Total Sales | F4 and F5 |

**Delivery Speed**

The Table (4-8) shows the delivery speed items and formula; the items are Operating Cycle and Inventory Turnover.

Table (4-8) Delivery Speed items Formulas

| Item | Formula | Forms |
|---|---|---|
| **Operating Cycle** | DIO + DSO – DPO* | F2 and F5 |
| **Inventory Turnover** | Cost of goods sold per average inventory | F2 and F5 |

*see Appendix A

**Product Mix**

Table (4-9) shows the product mix item and its scores, Iron and Steel corporations produce verity of rebar steel sections' diameter and length, beside that the Steelmakers produce wire mesh products, flat bars, square bars, and plane round bars, for each product produced the steelmakers will score 1 point.

Table (4-9) Product Mix Score estimated from Questionnaire Q5

| Product Mix | Score |
|---|---|
| **Steel Sections diameters** | |
| **8mm-12mm** | 1 point |
| **16mm-32mm** | 1 point |
| **Steel Section Length** | |
| **Lengths "6"m or "12"m** | 1 point |
| **Other Products** | |
| **Flat Bars** | 1 point |
| **Square Bars** | 1 point |
| **Plane round Bars** | 1 point |

**Volume Flexibility**

Table (4-10) shows the volume flexibility items and its scores, the volume flexibility for production will be indicated using literature review both sale seasonality index and price seasonality index, both indicators used the formula of the standard deviation per average for each year. The weights are 83% for sales seasonality index and 17% f or the price seasonality index where both are highly correlated in steel industry (Zawya & Global Research, 2009), these weights chosen because most of sales engineers and sales representative assured the researcher that sales represents more than 80 percent for overall production, on the other hand price seasonality is still

important according to literature and some of steelmakers shutdown their plant and stop manufacturing, but their trading activity is still valid, the only way to indicate their seasonality is by using the price seasonality indicators which also will be lowered due to low weight for this index.

Table 4-10 Volume Flexibility items Formulas

| Item | Formula | Weight | Forms |
|---|---|---|---|
| **Sales Seasonality Index** | Sales Standard Deviation per Sales Average | 5/6 | F2 |
| **Price Seasonality Index** | Price Standard Deviation per Price Average | 1/6 | F1 |



**4-3-4-2 Determine the Decision Actions for the period 2008-2012**

**Utilization**

Many Jordanian Iron and Steel Corporations attempt to achieve economics of scope by maximizing their capacity utilization for the highest level, accordingly, the local Steelmakers production levels exceed local demands (Department of statistics, 2006). The utility index is calculated by dividing the annual sales amount in tons produced over the Production capacity. Production design capacities are estimated to last available resource (Zawya & Global Research, 2009).

**Supply Chain vertical Integration**

Table (4-11) shows the vertical integrations items and scores; the actions includes upstream integration and downstream integration; the upstream integration represents the backward vertical integration strategy which contains scrap yard and electrical arc furnace factory within the Iron and Steel corporations, the downstream integration represents the forward vertical integration which complementary products for steel rebars which includes: wire mesh products, engineering sections, and cut and bend service.

Table (4-11) Supply Chain Management indicators with Iron and Steel Corporations

| **Supply Chain management** | **Electrical Arc Furnace** | |
|---|---|---|
| **upstream integration** | **Within** | **Without** |
| **Scrap Yard** | 3 points | 1 point |
| **EAF** | 3 points | 1 point |
| **Downstream integration** | **Availability level** | |
| | **Maximum** | **Minimum** |
| **Engineering Section** | 2 points | 1 point |
| **Wire mesh** | 2 points | 1 point |
| **Cut & Bend** | 2 points | 0 points |



**Location**

One of most strategic action choice infrastructure is the plant location, every city in Jordan was indicated by integer value; Amman city represented by "1", Zarqa represented by "2", Mafraq is represented by "3", Irbid is represented by "4", and Aqaba was represented by "5". The research should mention all the seven Iron and Steel corporations' plants' are in suburban area and not in Qualified Industrial Zones. Most of these manufacturers violate

treatments enact production plants within these Industrial site due to safety and environmental issues.

**Facility Layout Design**

While most of Iron and Steel corporations are using similar technologies for their rolling mills, their facility layout are quit the same. In construct, some Steelmakers had smelters where others don't. In same since the facility layout design for those having electrical arc furnace factories syringed with their rolling mills plants (*see table 4-12*).

Table (4-12) Facility Design Layout for EAF w/t Rolling Mills within the Jordanian Iron and Steel Corporations for the period (2008-2012)

| Facility Layout Design | Nominal value |
|---|---|
| Rolling Mills without EAF | 1 |
| Consolidated EAF with Rolling Mills | 2 |
| Combined EAF with Rolling Mills | 3 |



**4-3-4-3 Determine the Performance Indicators over the period 2008-2012**

Many different types used to indicates the performance indicators in the operations strategy taxonomies (e.g. Miller and Roth, 1994, Kathoria, 2000, Frohlich and Dixon, 2001, Sum *et al*., 2004, Zhao *et al*., 2006, Menor *et al*., 2001, Aranda, 2002, and Lowson, 2001). Most of the using self-reporting performance indicators (*see chapter 3 for more details*). some of these indicators refer to marketing, financial, and operational performance, on the other hand our research is using facts so the overall performance is limited to

data-collected, the research tries to imitate the performance indicators achieved by most recent taxonomies of operations strategy studies (e.g. Bülbül 2011, Grant *et al*., 2012).

Table (4-13) shows the performance indicators recruited in this research and its formula, the Performance Indicators used in this research project are: Relative Market Share, Sales Growth, Return on Asset, Return on Sales, and overall Performance.

Table (4-13) Performance Indicators components Formulas

| Components | Formula | Form |
|---|---|---|
| **Relative Market Share** | Sales per Sum of Sample Sales | F4 |
| **Sale Growth %** | Percent of Change on Sales | F4 |
| **ROA** | Profitability per Total liability and Assets | F4 |
| **ROS** | Profitability per Total Sales | F4 |
| **Overall Performance** | Average Scaled Performance Indicators | |

#### 4-3-4-4 Determine the manufacturing strategy variables scales over the period 2008-2012

To determine the tentative, sustained, and emerged optimal taxons, all manufacturing strategy variables measurements should be unified, the continuous facts used the research compare the Steelmakers capability performance and other continuous variables are scaled by using similar method used in 6 sigma Quality control Charts for each year separately (*see figure 4-2 as an demonstrative example*). The scale is categorize the variable performance to 6 intervals: (6: extensively high performance, 5: high performance, 4: above the average performance, 3: under the average performance, 2: low outperformance, 1: extensively low performance). The scale is segmented to intervals using both the average and standard deviation, each interval is increased by 1 standard deviation as following: from the average to 1 standard deviation is the fourth scale, from 1 standard deviation to 2 standard deviation is the fifth scale, above the 2 standard deviation is within the sixth scale, while the lower scales starts from the average to minus 1 standard deviation which is the third scale, the second scale is from minus 1 standard deviation to minus 2 standard deviation, and the first scale is below minus 2 standard deviation (Hint: this formula applied for all quantitative variable except the cost items and operation cycle which are reversed).

This technique is called: the standard deviation ranking method or simply SDRM.

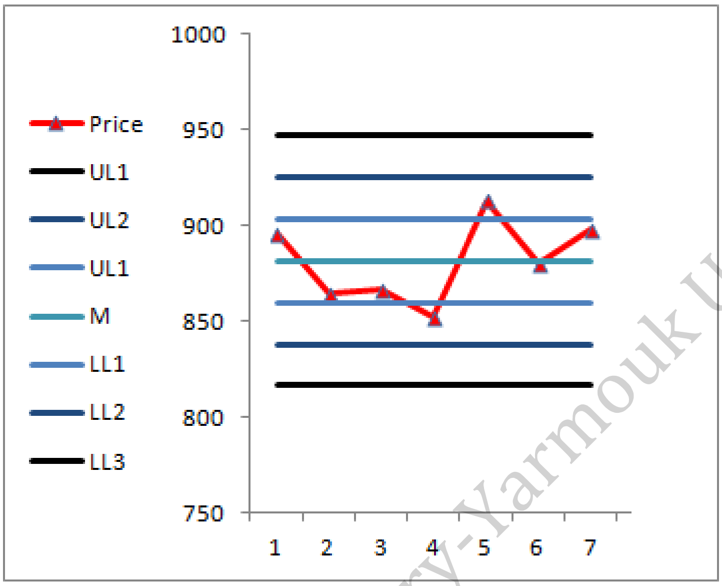



Figure (4-2) price in 2008 scale technique as example for the new scaling system; the standard deviation ranking method SDRM; accordingly, results are: 4, 3, 3, 2, 5, 3, and 4

The advantages for this technique method (standard deviation ranking method):

1- Allow the research to rank continuous data into unified scale.
2- This technique takes both the mean and the standard deviation in consideration, thus the intervals are more reasonable because they depends on the deviation.
3- The 6 intervals scale allows indicating the companies which have marginal outperform competitive capabilities, actions, and performance versus its competitors.
4- This technique determines the rank for positive, zero, and negative quantities which can't be used by SPSS ranking options.
5- The technique can be easily performed using Excel spreadsheet.

In order to transform the continuous facts to 6 points intervals the following procedure using Excel spreadsheet option "IF" statement to execute this option:

1- Firstly determine the mean value for quantitative quantity for certain year (e.g. the SSI for year 2008), the option can executed by "=average(A1:A7)" command,

2- then determine the standard deviation for the sample using "=stdev(A1:A7)" command.

3- then calculate the upper limits (UL1 = Average + Standard Deviation, UL2 = Average +2 x Standard Deviation, UL3 = Average + 3 x Standard Deviation) and the lower limits (LL1 = Average - Standard Deviation, LL2 = Average – 2 x Standard Deviation, LL3 = Average -3 x Standard Deviation) (*see table 4-14a*).

4- the variable values between the average and the UL1 will get score of 4, the variable values between the UL1 and the UL2 will get score of 5, the variable values between the UL2 and the UL3 will get score of 6, the variable values between the average and the LL1 will get score of 3, the variable values between the LL1 and the UL2 will get score of 2, and the variable values between the LL2 and the LL3 will get score of 1 (Hint the technique is reversed for the cost items such as the price and operating cycle).

using the function:

"IF(SSI>UL2;6;IF(SSI>UL1;5;IF(SSI>AVG;4;IF(SSI>LL1;IF(SSI>LL2;3;IF(SSI>LL1;2;1))))))

The function is reversed for the Cost variable and operating cycle, after determines the new ranking intervals; the outcomes represent the tentative values of quantitative quantities. Both emerged and sustained values will be determined lately in this chapter.

For the Nominal facts the scale already ranked by six intervals, which indicates the tentative values for the Nominal values (e.g. Quality conformance indicators). Both emerged and sustained values will be shown later.

Table (4-14a) Standard Deviation Rank method SDRM Intervals*

| Interval | Scale |
|---|---|
| UL3-UL2 | 6 |
| UL2-UL1 | 5 |
| UL1-AVG | 4 |
| AVG-LL1 | 3 |
| LL1-LL2 | 2 |
| LL2-LL3 | 1 |

*Mostly applied for tentative traits

Table (4-14b) SDRM Intervals* for Average Calculations

| Interval | Performance |
|---|---|
| 5 – 6 | very high performance |
| 4 – 5 | Above the Average Performance |
| 3- 4 | Average Performance |
| 2- 3 | Below the Average Performance |
| 1 -2 | Very low Performance |

*mostly applied for sustained and emergent traits



**4-3-4-5a Determine the tentative variable for manufacturing strategy over the period 2008-2012**

The results from the previous section represent the tentative variable, which will allow the researcher to track the significant taxons, actions and performance indicators, and evaluate the manufacturing decisions made over a series overview for both sample and period.

**4-3-4-5b Determine the Sustained variable for manufacturing strategy over the period 2008-2012**

By taking the average for each sample over the 5 years, this allowed the research to exam the strategic oversight for this critical period, and finds the significant actions and performance indicators resulted from the industrial groups.

**4-3-4-5c Determine the Emerged variable for manufacturing strategy for the period 2008-2012**

For the continuous data the maximum percentage change is the first step, the compare the results between the competitors using SDRM the result indicate the emerged variables.

Table (4-15) Emerged Variable formulas

| Variable | Standard Deviation | Score |
|---|---|---|
| Cause I | 0 | 1 |
| Cause II | None zero value | 6 |

After determining all the variables of manufacturing strategy according to tentative, sustained and emerged definitions, the third objective is fully satisfied.

Since the pervious technique is invalid to identify the emergent variable which use nominal scales or it continuous data remain the same over the study period, 6 points are assigned if there is a change in the nominal scale, if there is no change 1 pint is assigned for nominal and constant continuous data (*see table 4-15*).

## O4: Identifying the taxonomies of Iron and Steel corporations according to tentative, sustained and emerged operational capabilities in Jordan over the period (2008-2012).

## 4-3-5 Phase V: Cluster Analysis

### 4-3-5-1 Introduction to Cluster Analysis

**Cluster analysis** or simply **clustering** is the task of grouping a set of objects in such a way that objects called **cluster**, which are more similar to each other than to those in other groups (clusters). It is a main task of exploratory data mining, and a common technique for statistical data analysis used in many fields, including bioinformatics, machine learning, pattern recognition, image analysis, information retrieval, and recently management science.

Cluster analysis itself is not one specific algorithm, but the general task to be solved. It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them. Popular notions of clusters include groups with small distances among the cluster members, dense areas of the data space, intervals or particular statistical distribution. Clustering can therefore be formulated as a multi-objective optimization problem. The appropriate clustering algorithm and parameter settings (including values such as the distance function to use, a density threshold or the number of expected clusters) depend on the individual data set and intended use of the results. Cluster analysis as such is not an automatic task, but an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and failure. It will

often be necessary to modify data preprocessing and model parameters until the result achieves the desired properties.

In centroid-based clustering, clusters are represented by a central vector; this may not necessarily be a member of the data set. When the number of clusters is fixed to k, *K-means clustering* gives a formal definition as an optimization problem: find the $k$ cluster centers and assign the objects to the nearest cluster center, such that the squared distances from the cluster are minimized.

The optimization problem itself is known to be NP-hard, and thus the common approach is to search only for approximate solutions. A particularly well known approximate method is algorithm, often actually referred to as "*k-means algorithm*". It does however only find a local optimum, and is commonly run multiple times with different random initializations. Variations of k-means often include such optimizations as choosing the best of multiple runs, but also restricting the centroids to members of the data set (k-medoids) (Kanungo *et al*, 2002).

Most k-means-type algorithms require the number of the clusters - $k$ - to be specified in advance, which is considered to be one of the biggest drawbacks of these algorithms. Furthermore, the algorithms prefer clusters of approximately similar size, as they will always assign an object to the nearest centroid. This often leads to incorrectly cut borders in between of clusters (which are not surprising, as the algorithm optimized cluster centers, not cluster borders).

**4-3-5-2 identifying the tentative taxonomies of Iron and Steel corporations**

Using tentative manufacturing capabilities variables: (Cost, Quality Conformance, Quality Performance, Delivery Reliability, Delivery Speed, Product Mix, and Volume Flexibility) analyzed using SPSS K-means analysis within classify option, by using trial and error several times from 2-6 clusters, the outcomes with maximum number of significant variables will indicate the optimal taxonomies of manufacturing strategy can be achieved.

**4-3-5-3 identifying the Sustained taxonomies of Iron and Steel corporations**

Repeating the previous analysis by using sustained manufacturing capabilities variables, then determine the optimal taxons it by using SPSS K-means analysis within classify option, allowed to realize the optimal industrial group sustained within the past five years.

**4-3-5-4 identifying the emerged taxonomies of Iron and Steel corporations**

Repeating the previous analysis by using emerged manufacturing capabilities variables, then determine the optimal taxons it by using SPSS K-means analysis within classify option, allowed to realize the optimal industrial group emerged within the past five years.

## O5: Identifying the significant actions made to realize the taxonomies of manufacturing strategies by the Iron and Steel organizations in Jordan over the period (2008-2012).

**O6: Identifying the significant performance achieved through realizing the taxonomies of manufacturing strategies for the Iron and Steel organizations in Jordan over the period (2008-2012).**

Both objectives 5 and 6 are resolved via the sixth phase. The purpose of this phase is to determine the significant actions realized by optimal taxons, and to realize the significant performance achieved by the optimal taxons.

### 4-3-6 Phase VI: Determine the Significant Actions and Performance Indicators

In this phase the research identifies both significant decision actions and performance indicators determined as result from the realized taxonomies of manufacturing strategies according to tentative, sustained and emerged definitions. Kruskal Wallis non-parametric is used for this Purpose.

### 4-3-7 Phase VII: Conclusion, Discussion, and DSS for the taxonomies of manufacturing strategies

This Phase VII includes the final conclusion, discussion, and decision support system for the taxonomies of manufacturing strategies for the Jordanian Iron and Steel Manufacturers within the period 2008-2012, the competitive priorities within each taxon is realized, as well as each taxon is compound with significant actions, and performance achieved. The advanced tool using decision support system is developed to help the process decision-maker and the production manager will have the strategy to beware for future

according to tentative, sustained and emerged definitions. The future which we can't know, but we can predict using the information which we have.

## 4-4 Validity and Reliability

The Validity is achieved according to operational definition with derived from both literature review and the secondary literature, the research variable according to manufacturing strategy context was assured by specialist within the same industry.

Since the facts are used, the reliability is assured by researcher where he grantees his resources, the fact were collected by the researcher from the Sales reports, the Financial statements, Annual reports, Conformance and Performance certificate, and other statistical reports.

Some limitations surround the variables, the documents are hidden to reserve the confidentiality for respondents, some variable were estimated and forecasted within the period 2007-2013 because lack of information.

## 4-5 Software used for the Data-Analysis

The research recruits Microsoft® office excel 2010 spreadsheet and IBM SPSS statistics version 20. (*See table 4-16*).

The Excel spreadsheet used to summaries the data-analysis and to convert it to manufacturing strategy variables.

The k-means cluster analysis within the SPSS package used to identify the optimal taxons, and the level of significant for both actions and where using Kruskal Wallis within the SPSS software.

Table (4-16) Software and Instrument tools used Data-Collection and Data-Analysis

| Process | Instrument |
|---|---|
| Manufacturing strategy variables summaries | Excel spreadsheet |
| Manufacturing strategy variables according to (SDRM) | Excel spreadsheet |
| Variables according to tentative, sustained and emerged definitions | Excel spreadsheet |
| Taxonomies of manufacturing strategy | K-mean cluster analysis by SPSS |
| Significant Action developed by cluster | Kruskal Wallis by SPSS software |
| Significant performance developed by cluster | Kruskal Wallis with the SPSS software |

## 4-6 Summary

This chapter seeks to develop the empirical research phase in order to achieve the research aims and objectives, and show how to answer to the research question. The justifications for sample and time frame were discussed, the sample includes seven major Jordanian Steelmakers, and the period is the time between 2008 and 2012.

Data-Collecting instruments and Data-Analysis techniques are discussed, where special ranking method was used for the first time according to the researcher best knowledge, this scale is the standard deviation ranking method (SDRM) which connects the data-collection with the data-analysis.

The manufacturing strategy variables which are: the competitive capabilities, actions and performance indicators are measured via the intervals of (SDRM) for the continuous data, and ranked by 6 levels for the nominal values. This allowed the research to determine the optimal taxonomies of manufacturing strategies using K-means cluster analysis.

The manufacturing strategy variables are represented by tentative, sustained and emerged detentions. Using Kruskal Wallis both significant actions and performance achieved are determined.

The results allow the researcher to concludes, discuses, and the represents the decision support system, which will help the other researchers, observers, and superintendents to have better sight.

# Chapter 5

## Iron and Steel manufacturing strategies content

Chapter 5

# Iron and Steel manufacturing strategies content

## 5-1 Introduction

The purpose of this chapter is to configure the research conceptual model by identifying the research variables and their relationships. In response this chapter will achieves the first and the second objectives. The classifications related to Iron and Steel manufacturing competitive capabilities, decision actions, and performance indicators were realized by reviewing the previous studies. Finally, the taxon models were used to identify the taxonomies for Iron and Steel manufacturing strategies, so the maps that link the competitive capabilities with actions and performance indicators were developed by reviewing the suggested taxonomies.



## 5-2 Manufacturing Strategy Variables:

### 5-2-1 Manufacturing Capability (competitive priorities)

#### 5-2-1-1 Cost

Cost is usually a monetary valuation of effort, material, resources, time and utilities consumed, risks incurred, and opportunity forgone in production and delivery of a good or service. Iron and Steel manufacturers spurred them to expand aggressively their capacity all over the world (*International Institute of Steel & Iron*, 2008), focus on cost minimization through expanding their

capacity to satisfy the higher demand, often by keen so they compete on price competition (Storck, 2009).

Moreover, the cost capability is often driven by company efficiency, size, scale, scope and cumulative experience (porter, 1980); Iron and Steel manufacturers pursue marginal decrease in cost to achieve economies of scale, and achieving state-of-art which technologies decreasing their manufacturing process cycle in order to emerge economics of scope. This will involve tradeoffs between their capital investments, overhead, labor, Automation, and materials (Storck, 2009).

In Addition, In Jordan Iron and Steel industry considered being oligarchs competition, the research conduct with seven major Steelmakers represent over 80 present of market share for the year 2011 (Amman Chamber of Industry; Zarqa Chamber of Industry, 2013). There is pre-agreement for the Jordanian steel rebar (ASTM 615: Grade 40 and ASTM 615: Grade: 60) prices between the major Steelmakers sponsored by Amman chamber of industry since 2008 (Al-Rai, 2008). This practice limits super profit can be achieved by the local Jordanian Iron and Steel corporations.

Accordingly, the Cost Capability can be measured using **Price** which used under low price definitions (Miller and Roth, 1994), the Price will represents as the first item for the Cost components.

The operational cost which can be earned from the financial statements indicates the firm's policy for pursuing cost leadership strategy (Vickery *et al*, 2003). **Operating costs** are the expenditures used in manufacturing processes. Operational costs are the total sum for fixed and

variable costs, they are the cost of resources (such as: raw materials, Workers' Compensation, overhead costs, and other costs). Operational Costs divided by the total annual amount of sales represents the second items for the Cost components. The operational cost divided by the total annual amount of sales to eliminate the effect for economic of scales.

Since the Jordanian Steelmakers compete for marginal profit, the **Operating Profit** is recruited to represents as one of the cost items, operational revenue which is earned from a firm's normal core operations. This value does not include any profit earned from the firm's investments (such as earnings from in which the company has partial interest) and the effects of firm's interest and taxes. Operating profit eliminates pricing policy effect since we use the price as one of items of the cost components.

Operational Revenue divided by the Total amount of sales represents the third items for the Cost components. The operational revenue divided by the total annual amount of sales to eliminate the effect for economic of scales (*see table 5-1*).



Table (5-1) Items of Cost

| Item | Measurements |
|---|---|
| **Price** | JD |
| **Operational Cost by Total amount of Sales** | JD/Tons |
| **Operational Revenue by Total amount of Sales** | JD/Tone |

### 5-2-1-2 Quality

Quality is defined as a combination of quantitative and qualitative perspectives for which the product or service meets the customer's expectations (American Society for Quality, 2008), according to international standard terminologies (ISO 8402 :1986 standard) "the quality is the total of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs". There are five aspects of quality in a business context (Loughlin, 2008):

1. Producing or servicing by providing goods or service performance.
2. Checking whether that product or service is confirming to standard.
3. Quality Control of the process to ensure that the outcomes are with the anticipated tolerance.
4. Quality Management by directing the organization so that it optimizes its performance through analysis and improvement.
5. Quality Assurance by obtaining confidence that a product or service will be satisfactory.

Garvin's (1987) introduce eight dimensions which can be used to analyze quality characteristics in accordance to strategic level. Some of these dimensions are mutually exclusive, whereas others are dependent on other dimension but according to relative literature it is not cleared yet, but most importantly realizing the trade-offs desired by customers among these

dimensions can provide a competitive capability (Garvin, 1987). Eight dimensions can be summarized as follows:

1. Performance (will the product do its intended function?):

   Performance refers to a product's primary operating characteristics. This dimension of quality involves measurable attributes and can be measured physically according to specified need or standard.

2. Reliability (how often does the product fail?):

   Reliability is the consistent that product or service will sure it will remain functional within a specific time period without failure.

3. Durability (how long does the product last?):

   Durability measures the spam of a product's life while it's performing the main function without failure.

4. Features (what does the product also can do?):

   Features are the additional characteristics that are complimentary to the product or service main function.

5. Conformance (Does the product met the standard which was designed for?):

   Conformance is the precision with which the product or service meets the specified standards.

6. Serviceability (how easy is it to get maintenance?):

   Serviceability is the speed with which the product can be put into service when it breaks down, as well as the competence and the behavior of the serviceperson.

7. Aesthetics (to what extent the product appeal?):

   Aesthetics is the subjective dimension indicating the kind of response a user has to a product. It represents the individual's personal preference.

8. Perceived Quality (does the product make image for customer?):

   Perceived Quality is the quality attributed to a good or service based on indirect measures.

Quality as a variable used in manufacturing strategy context is determined by the items used in previous taxonomies of manufacturing strategy literature, which was the performance of quality and the conformance of quality (e.g. Miller and Roth 1994; Kathoria 2000; Frohlich and Dixon 2001; Zhao et al. 2006). Each of these components is mutually exclusive and will be defined as different manufacturing capabilities.

### 5-2-1-2a Quality Performance

Quality Performance is a numerical measurement of the performance of an organization, division, or process. Quality of performance can be accessed through measurements of physical products, statistical sampling of the output of processes, or through surveys of purchasers of goods or services. Also it

can be referred to the quality of service, any previous studies use quality performance as a variable for manufacturing capabilities within the taxonomies context (e.g. Miller and Roth 1994; Kathoria 2000; Frohlich and Dixon 2001; Zhao et al. 2006).

The research will indicate the scale of quality performance according to conformity with the Jordan Standards and Metrology Organization (JISM) and Royal Scientific Society specifications, because these organizations are responsible for the steel rebar products conformity, the American standard ASTM is very popular among the local Steelmakers, so the researcher will take it in consideration as item for the same component. Some Iron and Steel corporations make other standards or specifications; the capability is activated if the Steelmaker has metallurgy labs, strength of material labs and quenching process.

The research measured the quality performance through the conformity with the Jordanian Steel standards JSS, the ASTM standards and the capability to produce other specifications.

**5-2-1-2b Quality Conformance**

Quality of Conformance is the Level of production process conformance with design requirements or standards specifications effectiveness of the design and production functions in effecting the product manufacturing requirements and process specifications, while as meeting process control limits, product tolerances, and production targets. Many manufacturing studies consider this dimension (e.g. Nakane, 1986; Ferdows and De Meyer, 1990); Sine the research is using facts to indicate it variable, the quality

management certificate will be used to indicate quality conformance, Jordanian Steelmakers mostly seek to achieve the international standard (ISO 9001:2008), only three Iron and Steel corporations earned this certificate within the sample while others made internal program in order to achieve quality management system.

#### 5-2-1-3 Delivery

According to previous studies there are mainly two dimensions measure the delivery: which are the Delivery Reliability and Delivery Speed (Ward *et al.* 1996), where the two variables are mutually exclusive.

#### 5-2-1-3a Delivery Reliability

The Delivery reliability is the ability to deliver according to a promised schedule. Delivery Reliability considers being one of the most important competitive priorities (Ward *et al.,* 1996). Delivery reliability is sometimes referred to as dependability according to previous studies and concerns the ability to deliver according to a promised schedule or plan (Berry *et al.*, 1991; Menda and Dilts, 1997; Hill *et al.*, 1998).

Delivery Reliability defined as Ratio of the number of deliveries made without any error (regarding time, place, price, quantity, and quality) to the total number of deliveries in a period (Ward *et al.,* 1996).

The measurement of delivery reliability is obtained according to Hausman (1997) supply chain management model, measurement indicated by five indicators elements which are; product life cycle, contribution margin,

sales forecast error, number of markdown, and stock-out (Hausman, 1997). Since Innovative products are rare in with Iron and Steel industry, and it's hard to obtain forecast error, so the research will use the average of contribution margin, number of markdown, and stock-out indicators are measured by this research (*see delivery variable summary in table 5-2*).

### 5-2-1-3b Delivery Speed

Delivery speeds according to the previous studies are concerned with the length of the delivery cycle (Hallgren, 2007). Since the research using facts; the operating cycle and the inventory turnover represents the items of delivery speed components.

In common sense the operating cycle is the mean time taken by a firm in converting raw material back into cash, this operational definitions allow us to use operating cycle as item for speed components.

Inventory Turnover is a ratio which indicates how many times a company's inventory is sold and replaced over a period, which allows the research to use it as delivery speed complements (*see delivery variable summary in table 5-2*).

Table (5-2) Delivery Variables Components and its Items summary

| **Variable** | **Items** |
|---|---|
| **Delivery Reliability** | Contribution Margin |
| | Number of Markdown |
| | Stock-out Ratio |
| **Delivery Speed** | Operating Cycle |
| | Inventory Turnover |

### 5-2-1-4 Flexibility

While the flexibility is known as the ability of a manufacturing system to cost effectively vary its output within a certain range and given timeframe, there are three dimensions of flexibility most commonly pursued by manufacturers, these are related to product mix, volume, and changeover (Olhager, 1993; Hutchison and Das, 2007). Since our research is using quantitative quantities and hard facts the flexibility is indicated, using product mix and volume flexibility as components variables for flexibility (*see Flexibility variable summary in table 5-3*).

#### 5-2-1-4a Product Mix

**Product mix** is a range of associated products produced by a particular organization that yields larger sales revenue when marketed together than if they were marketed individually or in isolation from others achieving what we can called economics of scope (Martı´n-Pen˜a and Dı´az-Garrido, 2008). In this research the product mix is defined referred to the tensile grade available offered by Iron and Steel Corporations, the steel rebars sections diameter available, their length verity, and complementary products (such as square bars, flat bars, and plane round bars).

#### 5-2-1-4b Volume Flexibility

The **volume flexibility** is the ability to change production volume (Wood *et al*., 1990). The volume flexibility of Iron and Steel operations could define as the percentage of change in the production volume or sales as a response to seasonality variation. However, the accuracy of previous measure depends on the capacity strategy adopted by corporation, whether its level or chase, if the strategy is chase the previous measure is effective, however, it the level capacity is adopted the measure will be in effective since the production rate is stable. So another measure could be adopted which is the change in price as a response to seasonality variation (Chod *et al.,* 2006).

Table (5-3) Flexibility variable Components Items summary

| Variable | Items | Weights |
|---|---|---|
| **Product Mix** | Steel grades | N/A |
| | Steel Rebars sections diameter | 2/6 |
| | Steel Rebars length verity | 1/6 |
| | Other Products (square bars, flat bars, and plane round bars) | 3/6 |
| **Volume Flexibility** | Sales Seasonality Index | 5/6 |
| | Price seasonality Index | 1/6 |

Table (5-4) manufacturing capabilities components summary

| Competitive Capability | Components | Definitions* | Index |
|---|---|---|---|
| **Cost** | | Capability to compete on price | Price, OC/AS, and OR/AS |
| **Quality** | Performance quality | The capability to provide high performance products | Questionnaire Scale |
| | Conformance quality | The capability to offer consistent quality | Questionnaire Scale |
| **Flexibility** | Product Mix | The capability to deliver a broad product line | Tensile grades, Rebar sections diameter and length verity, other products |
| | Volume flexibility | The capability to respond to swings in volume | SSI and PSI |
| **Delivery** | Delivery speed | The capability to deliver products quickly | Inventory Turnover and Operating Cycle |
| | Delivery Reliability | The capability to deliver on time | Contribution Margin, Number of Markdown and Stock-out |

* Definitions source: (Miller and Roth, 1994)

### 5-2-2 Manufacturing Decisions

Manufacturing Decisions according to the literature review are categorized into structural and infrastructural actions (Hayes and Wheelwright, 1984), the manufacturing associated with policies areas are: the structural decisions , which includes: capacity, locations, facility layout design, process technologies, and vertical integration, on the other hand, the infrastructural decisions which includes: Production planning and control, human resource management, Quality Management and control, and recently environmental considerations or green operations actions.

Since the research is using facts, the research will investigate the manufacturing decisions associated with structural actions. The facts investigated the Jordanian Iron and Steel corporations are summarized in table (5-5) below.

The Actions related to infrastructural considered for most of the Local Steelmakers confidential, regardless this unfortunate statement, according to the researcher personal experience most of them have similar process technologies, procedures, and Manufacturing organization.

Table (5-5) actions used by the Jordanian Iron and Steel corporations

| Actions | Choice |
|---|---|
| **Capacity** | Utilization |
| **Vertical Integration** | Upstream Integration: using scrap yard and electrical arc furnace |
| | Downstream Integration: by producing engineering sections, wire mesh, cut & bend services |
| **Location** | City |
| **Facility Layout Design** | Consolidated or Combined with EAF |



### 5-2-3 Performance Indicators

The most investigated manufacturing performance indicators by manufacturing strategy research is the Financial, Marketing and Operational ratios (such as ROI, ROS, profitability, Market share, Sales Growth, and production efficiency), In construct the previous studies applied self-reporting methodologies to rate the performance indicators (e.g., Kathoria, 2000; Miller and Roth, 1994), while others (e.g., Sum *et al*., 2004) adopted a relative self-reporting financial performance in comparison with the competitors. The suggestion is that; performance should correspond to the strategic capabilities that define the manufacturing task (Richardson *et al*., 1985), followed by argue that; the content of manufacturing strategy is

correlated with the manufacturing performance that have an impact on the business unit. The facts are used by this research are both financial and marketing performance indicators.

Recent study shows different criteria in order to evaluate Performance indicator, the Performance indicator which is the reaction product of direct and indirect between the variables of the internal environment and the competitive environment in which their light will determine the financial market performance, power or resource, and the balance in the financial structure, or leverage, and capital investment, and cash position (Alsayah, 2009). Table (5-6) summaries the components of overall performance indicators used for this research.

Table (5-6) Performance Indicators Components

| Components | Category |
|---|---|
| **Relative Market share** | Marketing |
| **Sales Growth** | Marketing |
| **Return on Assets** | Financial |
| **Return on Sales** | Financial |

## 5-3 The Relationship between Manufacturing Variables

### 5-3-1 The Relationship between Manufacturing capabilities

Differentiation has a broad term meaning in a manufacturing strategy context, a greater level of detail is required when manufacturing prospective are added to the configurations; the manufacturer must also know the basis of that differentiation. Strategic manufacturing capabilities imply a position according to differentiation. Many manufacturers towards on cost (e.g. a manufacturer competes on the basis of cost leadership which, in turn, imputes a standardized product which leads to volume flexibility to achieve generic strategy).

On the other hand, Product differentiation through manufacturing can be achieved by using different choices of manufacturing capabilities, such as quality conformance or delivery dependability. An argue mention that quality and delivery dependability are practiced largely in manufacturing, while flexibility has low influence on product differentiation since it is most often of marginal benefit. As a matter of fact, flexibility is considered to a manufacturing capability which improve the product differentiation strategy rather than serving as the basis of differentiation.

There are many debates to the relationship between cost and quality, while many refer to the trade-off between the price point and the quality of a product or service. It is therefore one of the most critical decisions made by a firm, as it impacts on a number of key business drivers, including the brand of the firm, its commitment to its stakeholders and eventually to its bottom

line (hill, 1988). Many theorist and participant refer the inverse relationship between cost and cost of the quality (Feigenbaum, 1956), many other studies emphasize combinations of capabilities simultaneously, and for both cost and quality advanced method could be used such as Quality engineering (Taguchi , 1988) when he mentioned quality loss function.

The relation between the cost and flexibility elements depends on flexibility elements, for example volume flexibility enables the firm to produce above or below capacity within plausible cost in response to actual demand, so the advantage of economies of scale will be realized. However, product-mix flexibility entails the ability to make multiple products on the same capacity which will increase simultaneously the cost, while the design flexibility leads to increases in product complexity and development cost.

The relations between the quality and flexibility elements are controversial; both aimed to satisfy the customer wants. However, the achievement of one variable may affect the other, for example volume flexibility maximized by producing standard products which may not satisfies customer specific needs, on the other hand, standard products achieves high level of quality performance, so the relationship is not clear, but still an interrelation between these elements exists.

The relations between the delivery and flexibility elements reflected by flexibility targets, achieving economics of scale and scope will affect the delivery speed level by lowering the setup time and decreasing operating cycles, but clear relationship is still debatable, because most manufacturing

capabilities are mutually exclusive (*see table (5-7)*) *for the relationships summary between manufacturing capabilities*).

Table 5-7 summary of manufacturing capabilities relationships

| Manufacturing Capabilities | **cost** | **Performance quality** | **Conformance quality** | **Broad line** | **Volume flexibility** | **Delivery speed** | **Delivery Reliability** |
|---|---|---|---|---|---|---|---|
| Cost | | - | - | - | + | - | - |
| Performance quality | - | | + | 0 | - | - | + |
| Conformance quality | - | + | | 0 | - | - | + |
| Product Mix | - | 0 | 0 | | - | - | - |
| Volume flexibility | + | + | + | - | | + | + |
| Delivery speed | - | + | + | - | + | | + |
| Delivery Reliability | - | + | + | - | + | + | |

- + Positive relationship
- - Negative relationship
- 0 No relationship
- various resource was used

### 5-3-2 The relationship between capabilities and actions

Manufacturing capabilities are determined by set of actions. The manufacturing capabilities are formed by the objectives for the manufacturing system along with history of decision actions (Größler and Grübner, 2006). Moreover, Different levels of performance are achieved depending on set of capabilities originated from the system which affected by the production environments (such as: make to order, or make to stock). The manufacturing strategy comes through a pattern of decisions. Decisions within the manufacturing functions determine which resources to use, what routines to conduct, (e.g. what practices to employ and emphasize in order to achieve the manufacturing objectives). The set of practices, resources, routines used ultimately determine the operating characteristics of the manufacturing system, *i.e.* the manufacturing capabilities (Tan *et al.*, 2006).

Some of manufacturing capabilities are realized through structural actions, (such as cost and volume flexibility which are related to process technology), while others are realized through infrastructural actions (such Quality conformance is highly correlated with quality management system), other capabilities are realized by combination of both structural and infrastructural actions (such as delivery which has strong relationship with vertical integration, as well as Production and inventory planning). The previous studies of manufacturing strategy taxonomies avoid to conclude clear relation because the complexities and the verity of the industries among these studies without specialty in the scope. The relationships are summarized in table (5-8).

Table (5-8) The relationship between capabilities and actions

| Manufacturing Capabilities (competitive priorities) | Related Decisions used to maximize competitive priorities |
|---|---|
| **Cost** | Capacity utilization, Location, Workforce management, Facility Layout Design and process technology |
| **Quality Conformance** | Quality Management System |
| **Quality Performance** | Process Technology (CAD, CAM) |
| **Delivery Reliability** | Vertical Integration and Production Inventory Planning |
| **Delivery Speed** | Vertical Integration and Production/Inventory Planning |
| **Product Mix** | Process Technology (CAD, CAM) |
| **Volume Flexibility** | Capacity utilization, Workforce management, Facility Layout Design, Production Environment, and Production/Inventory Planning |

### 5-3-3 The relationship between capabilities and performance indicators

Performance measures which correspond to the manufacturing strategy groups, many theoretical and empirical studies shows that; capabilities: cost, quality, flexibility, delivery, and service, whether realized alone or togther leads to improved performance (Hayes and Upton, 1998; Tracey et al., 1999). However, the adverse results have been reported by some previous literature (Diaz et al., 2003; Swamidass and Kotha, 1998).

It is complex to indicate which competitive priorities enhances certain performance measure; porter (1980) emphasized achieved generic strategy by collaborating between cost leadership and another differentiation strategy can led the organization to outperform its competitors.



## 5-4 How to Identify the Taxonomies of Iron and Steel Corporations Manufacturing Strategies

The manufacturing strategy taxonomies include are indicated by: the relationships between manufacturing capabilities, the relationships between manufacturing capabilities and decision actions, and the relationships between manufacturing capabilities and performance indicators. Finally, the interrelationships between manufacturing capabilities determined by K-mean cluster analysis (*see chapter 4*), the significant actions achieved by optimal taxons is determined by the analysis of variance (*see chapter 4*), the same procedure repeated with performance indicators (*see chapter 4*).

Returning to literature review many taxonomies of manufacturing strategies were reprted, different set of combinations were optimal to realize

taxonomies of manufacturing strategy accessed with significant actions and performance indicators. The model includes three stages (*see figure 5-1*).




Figure 5-1 How to Identify Taxonomies of Manufacturing Strategies

Stage 1: this stage is realized by achieving the first three objectives (*see chapter 4*).

Stage 2: this stage is realized by reviewing the previos litratures (*see chapter 3*).

Stage 3: this stage is realized by achieving the last three objectives (*see chapter 4*).

## 5-5 Summary

The Taxonomies of manufacturing strategy are identified through three stages, by identifying the research variables and their relationships. Referring to the previous literature the research identified the scheme of classification for Iron and Steel manufacturing taxonomies. Both literature review and secondary literature used to identify the Iron and Steel manufacturing Competitive Capabilities, Decision actions, and Performance indicators.

# Chapter 6

## Data Analysis and Results

Chapter 6

# Data Analysis and Results

## 6-1 Introduction

The purpose of this chapter is to identify the optimal taxonomies for Iron and Steel manufacturing strategy according to tentative, sustained and emerged definitions. This chapter includes three approaches: tentative, sustained and emerged taxons. Using different analysis techniques the research led to different taxonomies of manufacturing strategies, which will eventually, will enhance the knowledge about of manufacturing strategies adopted by Jordanian manufacturing companies in general and the Jordanian Iron and Steel corporations in particular. This research project located within the framework of comparative studies, which will open the door to more depth studies on certain trait after realizing the manufacturing strategies for this sector and how its variable (competitive priorities, decisions and performance) interact and correlated with each other.

## 6-2 Jordanian Iron and Steel corporations Manufacturing Strategy Statistics for the period 2008-2012

### 6-2-1 Jordanian Iron and Steel corporations General characteristics and Statistics

The sample includes seven Iron and Steel corporations' respondents taken from 14 Steelmakers companies, the sample represents about 80% of market share within the Jordanian steel rebar steelmakers and 63% for the total steel market share for the year 2009 (Department of statistics, 2009). The reminder companies which didn't participate express their fears and reservation for the

study because it's using facts and quantitative quantities to resolve the research problem, while the researcher promised to protect the confidentiality for the participants Steelmakers (*see table 6-1*).

Table (6-1) Iron and Steel corporations encoding participated in the research

| **Steelmaker** | **Company 1** | **Company 2** | **Company 3** | **Company 4** | **Company 5** | **Company 6** | **Company 7** |
|---|---|---|---|---|---|---|---|
| **Encoding** | A1 | A2 | A3 | A4 | A5 | A6 | A7 |

The sample includes three companies registered in Amman Stock Exchange; other companies are distributed between limited public company, limited liability and private ownership. Only three Steelmakers have smelters within the sample, General statistics for Iron and Steel corporations participated in the study shown in table (6-2).

Table (6-2) Iron and Steel corporations sample general statistics for the year 2009

| **Respondent Steelmakers Characteristics** | **Statistics** | **Source** |
|---|---|---|
| Overhead Formation | 235 millions JD | Data-Collection |
| Amman Stock Exchange | 3 companies | http://www.ase.com.jo/ |
| ISO 9001:2008 | 3 companies | http://www.sgs.com/ |
| Total Sales Contribution | 217 millions JD | Data-Collection |
| Market share | 63% | Depart of Statistic 2009 |
| Production Capacity | 960,000 tons | Zawya & Global Research 2009 |
| Electrical Arc Furnace | 3 companies | Zawya & Global Research 2009 |

### 6-2-2 Jordanian Iron and Steel corporations manufacturing strategy variables for the period 2008-2012

The study variables categorized into three groups; which are competitive capabilities, actions, and performance indicators. These variables were traced within the period 2008-2009. Each of these variables is presented subject to tentative, sustained, and emerged definitions. The level of significance for this section is ( $\alpha = 0.05$).

The (competitive priorities) manufacturing capabilities includes: cost, quality conformance, quality performance, delivery reliability, delivery speed, product mix, and volume flexibility (*see table 6-3*).

Table (6-3a) Iron and Steel corporations manufacturing capabilities

| Variable | Mean | SD | T-Value | Sig | LL | UL |
|---|---|---|---|---|---|---|
| Cost | 3.4857 | .74249 | 27.774 | .000 | 3.2307 | 3.7408 |
| Q. Conformance | 3.6000 | 2.23870 | 9.514 | .000 | 2.8310 | 4.3690 |
| Q. Performance | 4.5714 | 1.37810 | 19.625 | .000 | 4.0980 | 5.0448 |
| Del. Reliability | 3.5048 | .52620 | 39.404 | .000 | 3.3240 | 3.6855 |
| Del. Speed | 3.4429 | .85553 | 23.808 | .000 | 3.1490 | 3.7367 |
| Product Mix | 3.3429 | 1.25892 | 15.709 | .000 | 2.9104 | 3.7753 |
| Volume Flex | 3.5571 | .49663 | 42.375 | .000 | 3.3865 | 3.7277 |

Table (6-3b) Iron and Steel corporations manufacturing capabilities correlations

| | | Cost | Quality Conformance | Quality Performance | Delivery Reliability | Delivery Speed | Product Mix | Volume Flex |
|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Cost | 1 | -.201 | -.159 | 0.07 | 0.018 | 0.149 | -.300 |
| | Quality Conformance | -.201 | 1 | .584** | 0.082 | -.117 | 0.145 | -.344* |
| | Quality Performance | -.159 | .584** | 1 | 0.236 | 0.067 | .456** | -.114 |
| | Delivery Reliability | 0.07 | 0.082 | 0.236 | 1 | .343* | -.042 | -.057 |
| | Delivery Speed | 0.018 | -.117 | 0.067 | .343* | 1 | -.092 | -.117 |
| | Product Mix | 0.149 | 0.145 | .456** | -.042 | -.092 | 1 | -.230 |
| | Volume Flexibility | -.300 | -.344* | -.114 | -.057 | -.117 | -.230 | 1 |
| | N | 35 | 35 | 35 | 35 | 35 | 35 | 35 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).





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Table (6-3a) shows the result of one sample t-test taking from 35 observations which represents the seven surveyed Steelmakers over the period 2008-2012, the purpose of this table to identify the capabilities show significant differences across industry, and it can be seen that all the capabilities are significant, and some variable are highly correlated where others are don't (*see table 6-3b*), these practices spur and gives indication to the researcher the companies tend establish generic strategies to survive, however most of these practices indicates average performing within the manufacturing capabilities, which indicates Jordanian Steelmakers should invest more in order to achieve competitive advantages.

The decision actions components are: capacity utilization, vertical integrated supply chain, Location, and facility layout design (*see table 6-4*).

Table (6-4) Decision Statistics

| **Variable** | **Mean** | **SD** | **T-Value** | **Sig** | **LL** | **UL** |
|---|---|---|---|---|---|---|
| Utilization | 3.4571 | .91853 | 22.267 | .000 | 3.1416 | 3.7727 |
| Upstream .I | 3.7143 | 2.00839 | 10.941 | .000 | 3.0244 | 4.4042 |
| Downstream .I | 3.3000 | 1.52528 | 12.800 | .000 | 2.7760 | 3.8240 |
| Location | 2.1429 | .64820 | 19.558 | .000 | 1.9202 | 2.3655 |
| Facility. L.D | 1.7143 | .89349 | 11.351 | .000 | 1.4074 | 2.0212 |

Using T-test obtained from 35 observations which represent the seven surveyed Steelmakers over the period 2008-2012. The results emphasize that Iron and Steel corporations made significant different decisions, the research

will investigate to what extant these decisions have been affected by taxons realized by Jordanian Steelmakers.

The performance indicators are presented by: relative market share, sales growth, return on asset, return on sales, and overall performance indicators (*see table 6-5*).

Table (6-5) Performance Indicators Statistics

| Variable | Mean | SD | T-Value | Sig | LL | UL |
|---|---|---|---|---|---|---|
| R. Market share | 3.5714 | .81478 | 25.932 | .000 | 3.2915 | 3.8513 |
| Sales Growth | 3.2571 | 1.01003 | 19.078 | .000 | 2.9102 | 3.6041 |
| Return on Asset | 3.4571 | .91853 | 22.267 | .000 | 3.1416 | 3.7727 |
| Return on Sales | 3.5429 | .88593 | 23.659 | .000 | 3.2385 | 3.8472 |
| Performance | 3.4571 | .49811 | 41.061 | .000 | 3.2860 | 3.6282 |



The Results showed that the Jordanian Iron and Steel corporations have been performed in different significant levels within the period 2008-2012, while most of the Steelmakers performed slightly below the average (where the average score is 3-4), this indicate the some companies may gained advantages to be in pioneer taxons to achieve this competitive advantage over this critical period.

## 6-3 Constructing the Tentative Taxonomies of Iron and Steel Manufacturing Strategy

K-mean cluster analysis is employed to realize the Tentative Taxonomies of Iron and Steel Manufacturing Strategy. The level of significant ( $\alpha = 0.05$).

The research used scale identified by 6 intervals, while many previous studies used Likert scale from 7 intervals since they use self-reporting methodology. This research project used quantitative quantities and facts (*see chapter 4*). The analysis was done using SPSS K-mean cluster analysis, several trial and errors done to estimate the optimal taxons with 20 iterations, optima taxonomies with three clusters (see results at table 6-6).

Table (6-6) Tentative Taxonomies of Manufacturing Strategy

| Competitive Capabilities | Manufacturing Strategic Group: Low emphasizers (n = 2) Group 1 | Lean production (n = 15) Group 2 | Differentiators (n = 18) Group 3 | F = Value P = Probability | |
|---|---|---|---|---|---|
| **Cost** | | | | | |
| **cluster mean*** | **4.33** | 3.42 | 3.44 | F= | 1.421 |
| **Rank**** | 1 | 5 | 5 | P= | .256 |
| **Standard Error***** | 0.666 | 0.185 | 0.172 | | |
| **Quality Conformance** | | | | | |
| **cluster mean*** | 1.00 | **6.00** | 1.89 | F= | 137.360 |
| **Rank**** | 6 | 1 | 7 | P= | .000 |
| **Standard Error***** | 0 | 0 | 0.24 | | |
| **Quality Performance** | | | | | |
| **cluster mean*** | 1.00 | **5.20** | 4.44 | F= | 15.456 |
| **Rank**** | 6 | 2 | 1 | P= | .000 |
| **Standard Error***** | 0 | 0.26 | 0.24 | | |
| **Delivery Reliability** | | | | | |
| **cluster mean*** | 3.00 | 3.47 | **3.59** | F= | 1.227 |
| **Rank**** | 3 | 4 | 4 | P= | .307 |
| **Standard Error***** | 0.116 | 0 | 0.138 | | |
| **Delivery Speed** | | | | | |
| **cluster mean*** | 3.00 | 3.20 | **3.69** | F= | 1.721 |
| **Rank**** | 3 | 7 | 3 | P= | .195 |
| **Standard Error***** | 0 | 0.2 | 0.214 | | |
| **Prodcut Mix** | | | | | |
| **cluster mean*** | 3.00 | **3.80** | 3.00 | F= | 1.813 |
| **Rank**** | 3 | 3 | 6 | P= | .179 |
| **Standard Error***** | 0 | 0.427 | 0.18 | | |
| **Volume Flexibility** | | | | | |
| **cluster mean*** | 3.50 | 3.30 | **3.78** | F= | 4.607 |
| **Rank**** | 2 | 6 | 2 | P= | .017 |
| **Standard Error***** | 0 | 0.117 | 0.108 | | |

*Represents the average degree of Importance attached to each competitive capability by cluster, Importance is measured on a six point SDRM scale. (Interval scale 1-6: 1 = very unimportant and 6 = very important)

**The rank order of importance of this competitive capability within the group

*** The standard error of the estimate of the mean for the group equals the standard deviation over the square root of n.

(Hint: The numbers in parentheses indicate the group numbers from which this is group was significantly different at the 0.05 level as indicated by the Scheffe pairwise comparison procedure. Numbers in **bold** indicate the highest group centroid for that measure. Group 1 = Low emphasizers, group *2* = Lean Production, group 3 = Differentiators. The observed F-statistics were derived from one-way ANOVAs and the p-values are associated with the observed F-statistics).

The Table (6-6) shows there are three taxonomies manufacturing capabilities variable successes to develop three manufacturing strategic groups. The significant manufacturing capabilities variables are: Quality conformance, Quality Performance, and Product Mix. However, The Manufacturing strategic groups developed were the Low emphasizers, Lean Production and Differentiators *(see figures 6-1, 6-2 and 6-3)*, where the centroid for each cluster is represented in these figures.

The results are consistent with manufacturing capabilities analysis, most of Jordanian Iron and Steel corporations, which tend to have average manufacturing capabilities performance. 2 observations where rate among Low emphasizers, while most observations among Differentiators which were 18, and 15 observations where within Lean Production group.

The results are consistent with manufacturing capabilities analysis, most of Jordanian Iron and Steel corporations, which tend to have below the average manufacturing capabilities performance. 2 observations where rate among Low emphasizers, while the other 18 observations among Differentiators, and 15 observations where within Lean Production group.

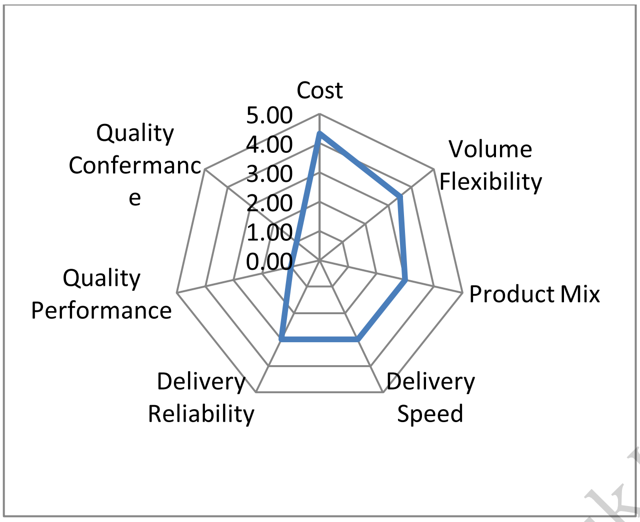



Figure 6-1 Low emphasizers Taxon

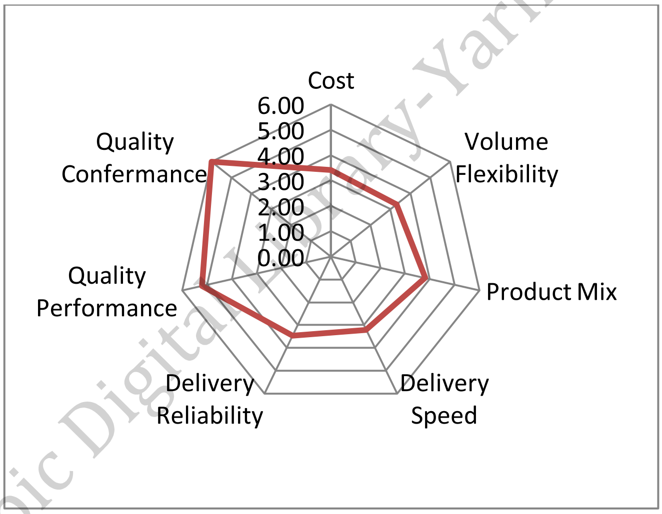



Figure 6-2 Lean Production Taxon

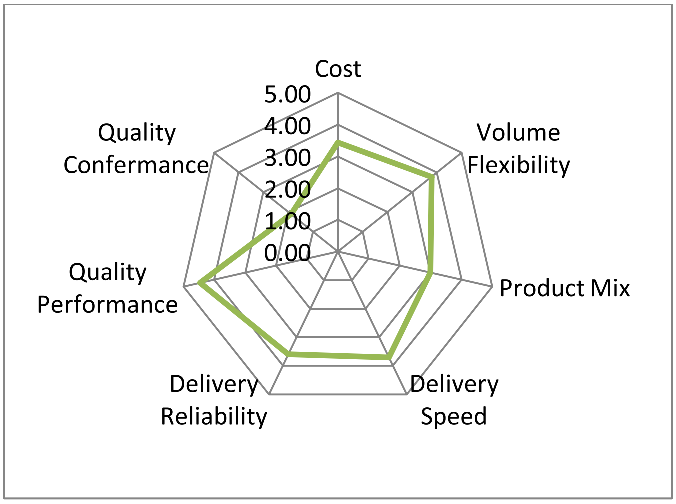



Figure 6-3 Differentiators Taxon

The Table (6-7) shows that some Steelmakers changes their manufacturing strategic groups within the period (2008-2012) according to changing manufacturing capabilities, the research used Friedman test, these results infer that companies changes their operational decision according to external, industrial, and internal environments. The operational decisions based on daily bases have more influence on actions and performance as the research continues its analysis.

Table (6-7) Changes in tentative taxonomies of manufacturing strategy within Steelmakers in the period (2008-2012)

| Company | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| **A1** | Differentiators | Differentiators | Differentiators | Differentiators | Differentiators |
| **A2** | Lean Production | Lean Production | Lean Production | Lean Production | Lean Production |
| **A3** | Lean Production | Lean Production | Lean Production | Lean Production | Lean Production |
| **A4** | Differentiators | Differentiators | Differentiators | Low emphasizers | Differentiators |
| **A5** | Lean Production | Lean Production | Lean Production | Lean Production | Lean Production |
| **A6** | Differentiators | Differentiators | Differentiators | Differentiators | Differentiators |
| **A7** | Differentiators | Differentiators | Differentiators | Low emphasizers | Differentiators |
| **Chi-Square** | 60.37 | **Sig** | .000 | | |

The sustainable taxons will indicate to what extant these manufacturing groups affect decisions and performance made by Jordanian

Iron and Steel corporations. the research analyzed the optimal tentative manufacturing strategic group with decision made by Iron and Steel corporations during the period 2008 to 2012 (*see table 6-8*), the research also will conduct the achieved performance according to significant industrial groups for the same period (*see table 6-9*). Both analysis used Kruskal Wallis Analysis of Variance techniques (*see chapter4*).

Table (6-8) Tentative Decisions Analysis

| **Decisions** | **Utilization** | **Upstream Integration** | **Downstream Integration** | **Location** | **Facility Layout Design** |
|---|---|---|---|---|---|
| Low emphasizers | 13 | 10.50 | 10.5 | 23.0 | 23.0 |
| Lean Production | 19.2 | 22.17 | 22.17 | 11.33 | 21.33 |
| Differentiators | 17.56 | 15.36 | 15.36 | 23.0 | 16.06 |
| Chi-Square | .825 | 6.454 | 5.502 | 14.104 | 4.198 |
| Significant | .662 | .040 | .064 | .001 | .123 |

Table (6-7) shows that manufacturing strategic group has been effected by decision made by Jordan Iron and Steel corporations for the period 200-2012. Low emphasizers, Lean Production and Differentiators are formulated by decision made related to upstream integration and downstream integration. and Location, However, Utilization and Facility layout design related decisions has no significant rule in these industrial groups, but still has influence. Previous studies indicate some decisions where significant such as location and vertical integrations other decisions were not (Martı´n-Pen˜a and Dı´az-Garrido, 2008).

The next table (6-9) identifies the influence made by Iron and Steel taxonomies on the performance achieved by Jordanian steel makers.

Table (6-9) Tentative Performance Indicators

| Decisions | Relative Market share | Sales growth | Return on Asset | Return on Sales | Overall Performance |
|---|---|---|---|---|---|
| Low emphasizers | 11.0 | 15.5 | 19.25 | 6.75 | 8.25 |
| Lean Production | 22.17 | 17..03 | 20.5 | 17.23 | 20.37 |
| Differentiators | 15.31 | 19.08 | 15.78 | 19.89 | 17.11 |
| Chi-Square | 5.690 | .497 | 2.039 | 3.545 | 2.834 |
| Significant | .050 | .780 | .361 | .170 | .242 |

The table (6-9) shows that there is no significant performance indicators reflected by the manufacturing strategic group except for the relative market share indicator. The most Iron and Steel corporations suffered after the global crisis and the local recession, most of these Steelmakers are aimed to survive even the major companies such as Jordan Steel, not attempting to achieve superior performance.

## 6-4 Constructing the Sustained Taxonomies of Iron and Steel Manufacturing Strategy

The main purpose for sustained taxonomies to exam the Steelmakers capabilities, actions and performance indicators within the period 2008-2012. The average performance with these year indicated to what extant Iron and Steel corporations sustain their manufacturing capabilities, and how the manufacturing strategic groups affected by long-term decisions made by Jordanian Steelmakers (*see table 6-10*).

Table (6-10) Sustained Taxonomies of Manufacturing Strategy

| Competitive Capabilities | Manufacturing Strategic Group: Low emphasizers (n = 4) Group 1 | Lean production (n = 1) Group 2 | Differentiators (n = 2) Group 3 | F = Value P = Probability | |
|---|---|---|---|---|---|
| **Cost** | | | | | |
| **cluster mean*** | 3.55 | **3.73** | 3.20 | *F*= | 0.580 |
| **Rank**** | 4 | 4 | 6 | *P*= | .601 |
| **Standard Error***** | 0.22 | 0.26 | 0 | | |
| **Quality Conformance** | | | | | |
| **cluster mean*** | 2.00 | **6.00** | **6.00** | *F*= | 13.714 |
| **Rank**** | 7 | 1 | 1 | *P*= | .016 |
| **Standard Error***** | 0.58 | 0 | 0 | | |
| **Quality Performance** | | | | | |
| **cluster mean*** | 4.80 | **6.00** | 4.60 | *F*= | 0.794 |
| **Rank**** | 1 | 1 | 2 | *P*= | .513 |
| **Standard Error***** | 0.49 | 0.58 | 0 | | |
| **Delivery Reliability** | | | | | |
| **cluster mean*** | **3.53** | **3.53** | 3.43 | *F*= | .059 |
| **Rank**** | 5 | 6 | 3 | *P*= | .943 |
| **Standard Error***** | 0.18 | 0.14 | 0 | | |
| **Delivery Speed** | | | | | |
| **cluster mean*** | **3.63** | 3.10 | 3.25 | *F*= | 0.293 |
| **Rank**** | 3 | | | *P*= | .760 |
| **Standard Error***** | 0.417 | 0 | 0.25 | | |
| **Prodcut Mix** | | | | | |
| **cluster mean*** | 3.00 | **6.00** | 2.50 | *F*= | 7.143 |
| **Rank**** | 6 | 1 | 7 | *P*= | .048 |
| **Standard Error***** | 0.41 | 1.2 | 0 | | |
| **Volume Flexibility** | | | | | |
| **cluster mean*** | **3.75** | 3.20 | 3.35 | *F*= | 20.694 |
| **Rank**** | 2 | 7 | 4 | *P*= | .008 |
| **Standard Error***** | 0.05 | 0.06 | 0 | | |

*Represents the average degree of Importance attached to each competitive capability by cluster, Importance IS measured on a six point SDRM scale. (Interval scale 1-6: 1 = very unimportant and 6 = very important)

**The rank order of importance of this competitive capability within the group

*** The standard error of the estimate of the mean for the group equals the standard deviation over the square root of n.

(Hint: The numbers in parentheses indicate the group numbers from which this is group was significantly different at the 0.05 level as indicated by the Scheffe pairwise comparison procedure. Numbers in **bold** indicate the highest group centroid for that measure. Group 1 = Low emphasizers, group *2* = Lean Production, group 3 = Differentiators. The observed F-statistics were derived from one-way ANOVAs and the p-values are associated with the observed F-statistics).

The results emphasize that three sustained manufacturing capabilities were responsible for realizing three manufacturing strategic groups, quality conformance, product mix and volume flexibility are the sustained capability are responsible for realizing Low emphasizers, Lean Production and Differentiators groups to be sustained for the past five years (*see Figures 6-4, 6-5 and 6-6*) where the centroid for each cluster is represented in these figures.

. Quality conformance achieve through quality management program, in order to maintain QMS programs they need commitment from the higher management levels, which needs long-term investment to realize it. However, volume flexibility can be achieved by tracking supply and demand level, most Jordanian Steelmakers following capacity production environment since they use continuous process layout within their rolling mill plants, to lower startup and setup costs. Finally, Jordan Iron and Steel corporations used fully-automated rolling mills which enable them to producing verity of products needed for the local market; on the other hand many Jordanian Steelmakers favor to produce heavy sections to utilize their capacity. Next section indicates to what extant long-terms stable decision affected by the sustained manufacturing strategic group (see table 6-11).

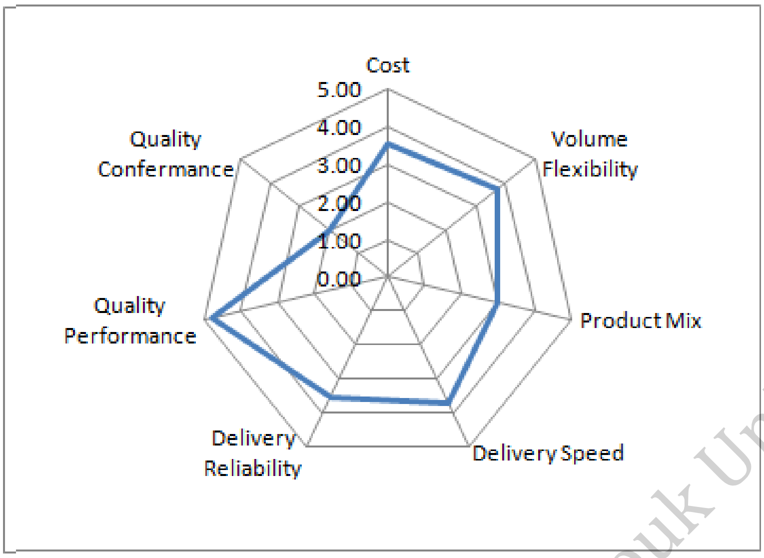



Figure (6-4) Low Emphasizers

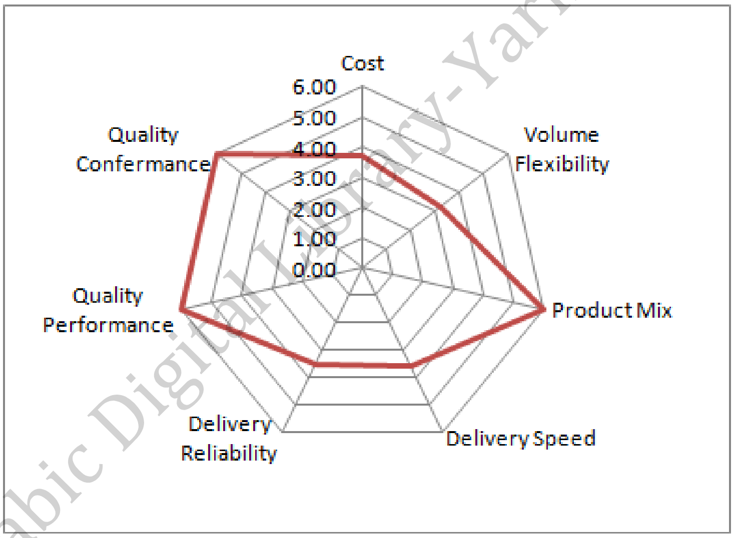



Figure (6-5) Lean Production

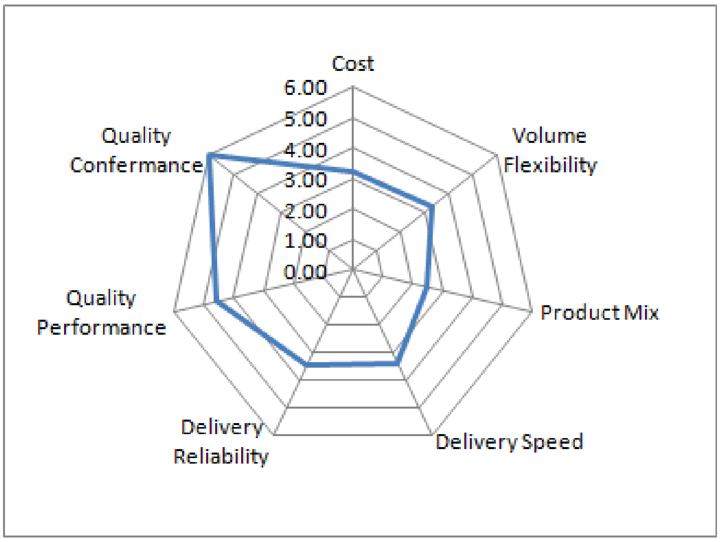



Figure (6-6) Differentiators

Table (6-11) Sustained Decisions Analysis

| **Decisions** | **Utilization** | **Upstream Integration** | **Downstream Integration** | **Location** | **Facility Layout Design** |
|---|---|---|---|---|---|
| Low emphasizers | 3.63 | 3.38 | 3.38 | 5.00 | 3.50 |
| Lean Production | 7.00 | 6.00 | 6.00 | 3.50 | 5.00 |
| Differentiators | 3.25 | 4.25 | 4.25 | 2.25 | 4.50 |
| Chi-Square | 2.515 | 1.625 | 1.625 | 2.767 | .667 |
| Significant | .284 | .444 | .444 | .251 | .717 |

Table (6-11) shows that sustained manufacturing strategic groups has been not significant influence for the long-term decisions, which indicates most of the Jordanian Iron and Steel corporations relays more on spontaneous decisions, this conclusion is consistent with the researcher experience; most Iron and Steel corporations decisions are made according to judgmental thoughts not based on deep analysis. The opinion of dominant collations (Child, 1972) is effect only for the short-run, while long-term decisions should lead to competitive advantage. As a strategic group categorized with respect to structural and infrastructural decision; most of Jordanian Iron and Steel corporations tries to imitate each other so no significant actions are realized to achieve superior performance, which will be our next discussion (*see table 6-12*).

Table (6-12) Sustained Performance Indicators

| Decisions | Relative Market share | Sales growth | Return on Asset | Return on Sales | Overall Performance |
|---|---|---|---|---|---|
| Low emphasizers | 3.75 | 3.25 | 3.25 | 3.88 | 3.50 |
| Lean Production | 7.00 | 6.00 | 5.00 | 2.00 | 6.00 |
| Differentiators | 3.00 | 4.50 | 5.00 | 5.25 | 4.00 |
| Chi-Square | 2.596 | 1.558 | 1.145 | 1.568 | 1.071 |
| Significant | .273 | .459 | .564 | .457 | .585 |

As predicted under the circumstances of global crisis and the Jordanian recession. Jordanian Steelmakers maintain themselves within the average performance, that's indicate most of manufacturing companies in general and Steelmakers in particular in Jordan within the period 2008-2012, have utilized manufacturing strategic groups to survive the crisis not to achieve competitive advantages. This led us to exam the emergent decisions have been made to enact with this dilemma, and to what extant Jordanian steelmakers react during the financial crisis.

## 6-5 Constructing the Emerged Taxonomies of Iron and Steel Manufacturing Strategy

The main purpose for this sections is to construct the emerged taxonomies of Iron and Steel Manufacturing Strategy realized by the Jordanian Steelmakers over the period 2008-2012 and exam to what extant these manufacturers deal with the global and the local crisis accrued within the same period.

While many local industries suffered from the global financial crisis and the local Jordanian recession as mentioned in the literature review, many Jordanian manufacturing organizations didn't survive (e.g. Modern Aluminum Industries with the study period). Even with Steel industries some companies terminated their activity (e.g. Philadelphia Steel Industries and Middle East Iron and Steel Company), on the other hand some investors enter the steel market (e.g. Teebah Steel Industries in 2012), beside that some Steelmakers within the sample start emphasizing on vertical integration by constructing and acquiring electrical arc furnace smelters. Table (6-13) shows emerged taxons which made by the manufacturing.

Table (6-13) Emergent Taxonomies of manufacturing strategies

| | Manufacturing Strategic Group | | | | |
|---|---|---|---|---|---|
| | Low emphasizers (n = 2) Group 1 | Integrators (n = 4) Group 2 | Reactor (n = 1) Group 3 | F = Value P = Probability | |
| **Competitive Capabilities** | | | | | |
| **Cost** | | | | | |
| **cluster mean*** | 2.00 | **4.25** | 4.00 | *F=* | 18.571 |
| **Rank**** | 5 | 1 | 3 | *P=* | .009 |
| **Standard Error***** | 0 | 0.25 | 0 | | |
| **Quality Conformance** | | | | | |
| **cluster mean*** | 1.00 | **1.00** | 1.00 | *F=* | 0.000 |
| **Rank**** | 6 | 5 | 6 | *P=* | N/A |
| **Standard Error***** | 0 | 0 | 0 | | |
| **Quality Performance** | | | | | |
| **cluster mean*** | **3.50** | 1.00 | 1.00 | *F=* | 1.429 |
| **Rank**** | 3 | 5 | 6 | *P=* | .340 |
| **Standard Error***** | 3.5 | 0 | 0 | | |
| **Delivery Reliability** | | | | | |
| **cluster mean*** | 2.50 | 3.75 | **4.00** | *F=* | 1.516 |
| **Rank**** | 4 | 2 | 3 | *P=* | .323 |
| **Standard Error***** | 0.5 | 0.48 | 0 | | |
| **Delivery Speed** | | | | | |
| **cluster mean*** | **4.00** | 3.50 | **4.00** | *F=* | 0.171 |
| **Rank**** | 1 | | | *P=* | .848 |
| **Standard Error***** | 1 | 0.5 | 0 | | |
| **Prodcut Mix** | | | | | |
| **cluster mean*** | 1.00 | 1.00 | **6.00** | *F=* | 0.000 |
| **Rank**** | 6 | 5 | 1 | *P=* | N/A |
| **Standard Error***** | 0 | 0 | 0 | | |
| **Volume Flexibility** | | | | | |
| **cluster mean*** | 4.00 | 2.75 | **5.00** | *F=* | 3.610 |
| **Rank**** | 1 | 4 | 2 | *P=* | .127 |
| **Standard Error***** | 0 | 0.48 | 0 | | |

*Represents the average degree of Importance attached to each competitive capability by cluster, Importance IS measured on a six point SDRM scale. (Interval scale 1-6: 1 = very unimportant and 6 = very important)

**The rank order of importance of this competitive capability within the group

*** The standard error of the estimate of the mean for the group equals the standard deviation over the square root of n.

(Hint: The numbers in parentheses indicate the group numbers from which this is group was significantly different at the 0.05 level as indicated by the Scheffe pairwise comparison procedure. Numbers in **bold** indicate the highest group centroid for that measure. Group 1 = Low emphasizers, group *2* = Integrators, group 3 = Reactors. The observed F-statistics were derived from one-way ANOVAs and the p-values are associated with the observed F-statistics).

Table (6-13) shows that the Iron and Steel corporations react differently and the change on manufacturing capabilities effect the manufacturing strategy groups' formations. The problem within the Jordanian Iron and Steel sector start in 2008 as mentioned in literature review, the steel price surpassed the price of 1200 (Al-Rai, 2008). This emphasized the local Steelmakers to decrease their operational cost and lower their prices and leverage sever losses, which lead to gain cost as significant variable categories manufacturing strategic groups. New groups have been formed: Low emphasizers, Integrators and Reactors (*see Figures 6-7, 6-8 and 6-9*) where the centroid for each cluster is represented in these figures.

Now the research will exam the decisions have been made to lower their operational cost, as well as to what extant these action affected by group formation spontaneously to react with different industrial and environmental extreme change within this critical period (*see table 6-14*).

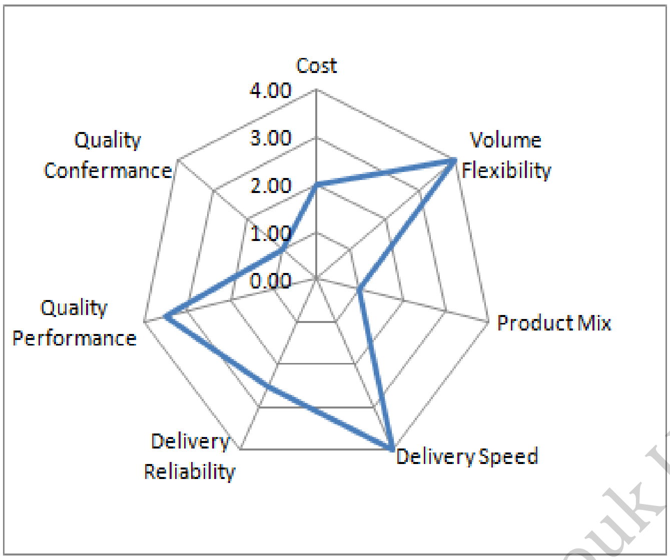



Figure (6-7) Low Emphasizers

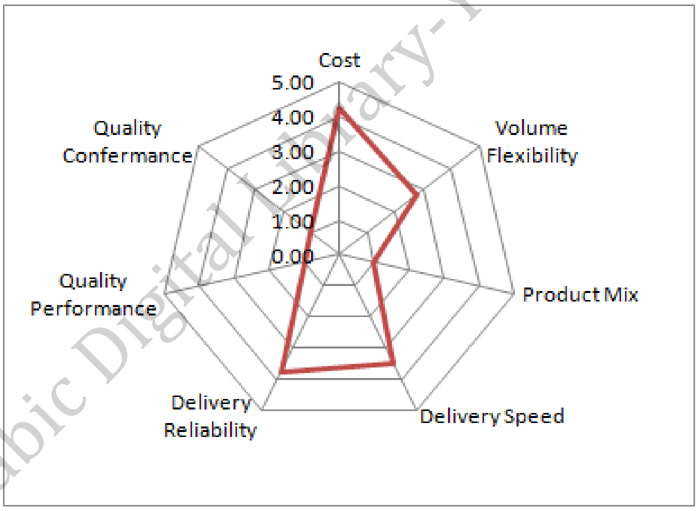



Figure (6-8) Integrators

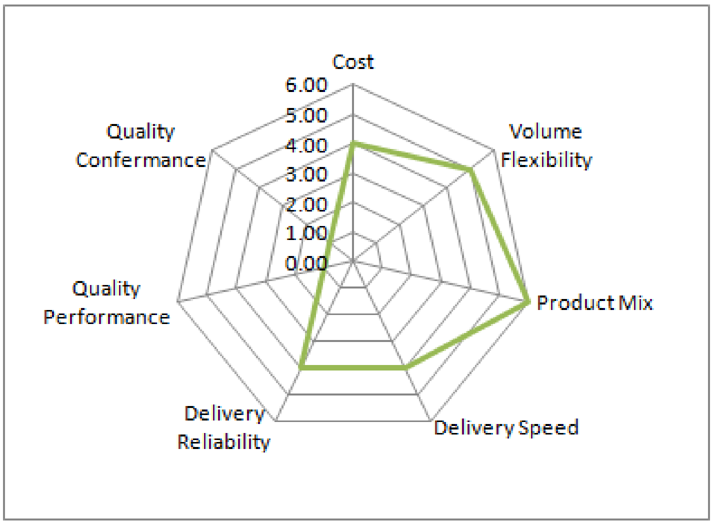



Figure (6-9) Reactors

Table (6-14) Emergent Decisions Analysis

| Decisions | Utilization | Upstream Integration | Downstream Integration | Location | Facility Layout Design |
|---|---|---|---|---|---|
| Low emphasizers | 2.25 | 4.00 | 3.50 | 4.00 | 4.00 |
| Lean Production | 4.38 | 4.00 | 4.38 | 4.00 | 4.00 |
| Differentiators | 6.00 | 4.00 | 3.50 | 4.00 | 4.00 |
| Chi-Square | 2.788 | .000 | .750 | .000 | .000 |
| Significant | .248 | 1.000 | .687 | 1.000 | 1.000 |

The table (6-14) indicates the emerged actions didn't influence the manufacturing strategic groups, which means the decision-makers within the steel industry don't rush their decisions even in critical situation, furthermore, there were no actions made to deal with crises on actions level, which means that the Jordanian Steelmakers are reconsidering their investments within the steel industry which is jeopardize to risk. Steelmaking is one of hard liquidate industry (Worthington and Britton, 2006).

Table (6-15) with examines to what extant Iron and Steel corporations preformed according to strategic group emerged within the period 2008-2012.

Table (6-15) Emergent Performance Indicators

| Decisions | Relative Market share | Sales growth | Return on Asset | Return on Sales | Overall Performance |
|---|---|---|---|---|---|
| Low emphasizers | 6.50 | 3.50 | 2.50 | 3.00 | 2.00 |
| Lean Production | 4.75 | 4.38 | 4.50 | 4.13 | 4.38 |
| Differentiators | 3.00 | 3.50 | 5.00 | 5.50 | 6.50 |
| Chi-Square | 3.900 | .342 | 1.472 | 1.015 | 3.485 |
| Significant | .142 | .843 | .479 | .602 | .175 |

Table (6-15) shows that Iron and Steel corporations performance didn't affected significantly by the emerged strategic group formed. The cost capability which is the significant factor where Steelmakers tried to categories has no tangible effect in both emergent decisions and performance indicators within the period 2008-2012.

Table (6-16) The Summary of Taxonomies of Jordanian Iron and Steel Manufacturing Strategy over the period 2008-2012

| | **Group 1** | **Group 2** | **Group 3** | **Significant Capabilities** | **Significant Decisions** | **Significant Performance** |
|---|---|---|---|---|---|---|
| **Tentative** | Low Emphasizers | Lean Production | Differentiators | QC, QP, DS and PM | U, USI and DSI | RMS |
| **# of traits w/n each group** | 2 | 15 | 18 | | | |
| **Sustained** | Low Emphasizers | Lean Production | Differentiators | QC, PM and VF | N/A | N/A |
| **Companies w/n each group** | A1, A4, A6, A7 | A2 | A3, A5 | | | |
| **Tentative** | Low Emphasizers | Integrators | Reactors | Cost | N/A | N/A |
| **Companies w/n each group** | A1, A5 | A2, A4, A5, A6 | A3 | | | |

## 6-6 Summary

According to tentative, sustained and emergent definitions, the manufacturing strategic groups were developed within the Jordanian Iron and Steel corporations within the period 2008-2012. Tentative manufacturing strategy taxonomies formulated by 3 significant capabilities, while sustained manufacturing strategy taxonomies were formed by 3 significant manufacturing capabilities, moreover, only one manufacturing capabilities was responsible for emergent taxonomies of manufacturing strategy.

Moreover, tentative strategic groups achieved by significant actions and outperform each others in certain indicators. However, both emergent and sustained manufacturing strategic groups was unable to explain the effect of both decision for long-term or emergent decisions over the critical period 2008-2012, as well as emergent and sustained industrial groups was unable to state significant effect with performance indicators.

Next chapter will presents Decision Support System, can be used for Iron and Steel corporations as a tool for operational decisions.

# Chapter 7

## Decision Support System

Chapter 7

# Decision Support System

## 7-1 Introduction

This chapter presents the decision support system (DSS) which was developed from prediction models of taxonomies of manufacturing strategy. The chapter includes the reasons for using DSS, how it was developed, and how to use it to help production superintendents in their decision-making process within Iron and Steel industry.

## 7-2 Reasons for Presenting Taxonomies of Manufacturing Strategy in a Decision Support System

The decision support system will deal with only one period to present the predicted taxons for 4 companies, theses taxons were identified within tentative definitions. The taxons are low emphasizers, lean production, and differentiators.

Further, the prediction models give tentative taxons, which allow the company to exam its capabilities according to three competitors. The results are estimated to simple cluster algorithm using 2 iterations for centriod-cluster, where in the original data analysis the research used 20 iterations to reach the optimal taxons.

The research hoped to help productions and operations mangers on their daily basis decision acts sense it's the most critical aspect the research concluded (*see chapter 8*).

## 7-3 How the Decision Support System was developed




Figure (7-1) Decision Support System Interface

The DSS was developed for the purpose to help decision-makers and researcher to identify the taxonomies of manufacturing strategy.

## 7-4 How to use the Decision Support System

1- Click on DSS excel icon on the attached CD.

2- The taxonomies of manufacturing strategy interface will appear, the worksheets were labeled according to data entry, please choose the data label you will enter the data according to (figures *7-2, 7-3, 7-4, 7-5, 7-6. and 7-7*) in by click on the label, now you can fill the information for 4 companies which are (Price F1, Sales F2, Finance F4, Inventory F5, Questionnaire Q3, and Questionnaire Q5).




Figure (7-2) Price F1 data entry

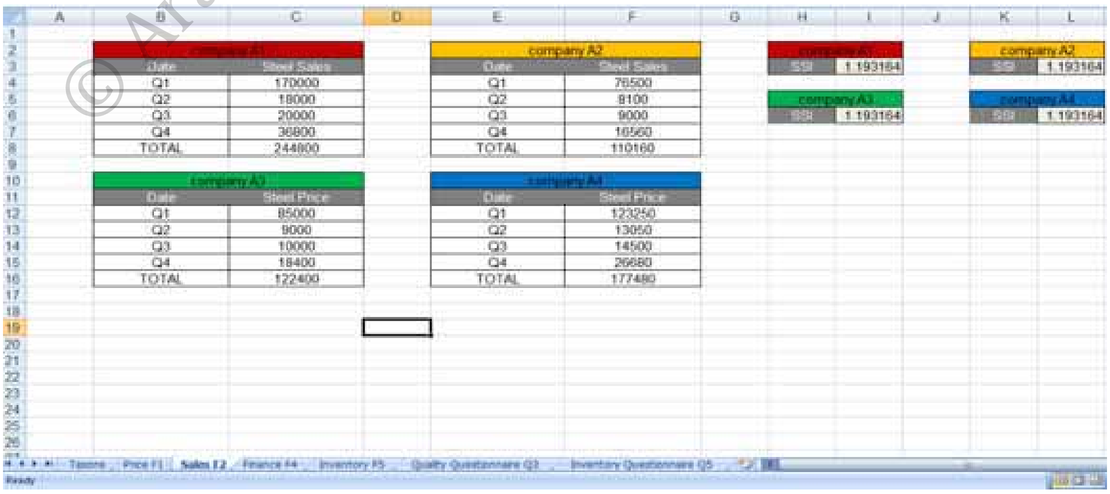
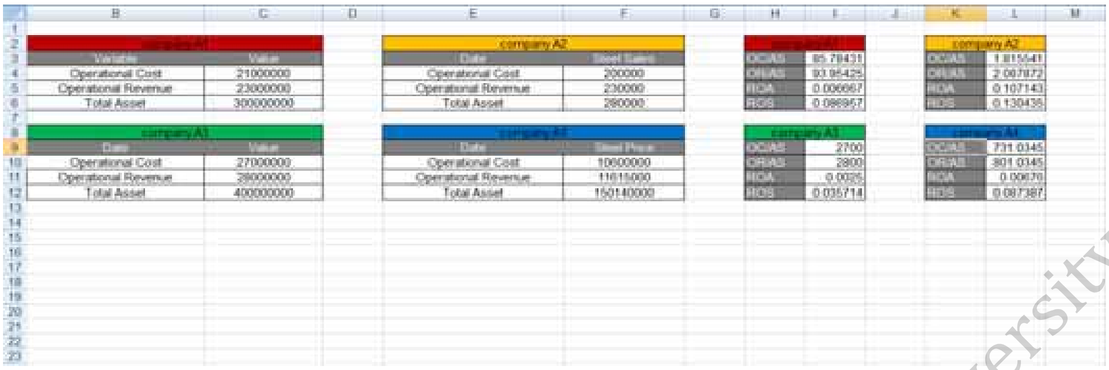



Figure (7-3) Sales F2 Sales/Production data entry



| company A1 | |
|---|---|
| Variable | Value |
| Operational Cost | 21000000 |
| Operational Revenue | 23000000 |
| Total Asset | 300000000 |

| company A2 | |
|---|---|
| Date | Steel Sales |
| Operational Cost | 200000 |
| Operational Revenue | 230000 |
| Total Asset | 280000 |

| company A3 | |
|---|---|
| Date | Value |
| Operational Cost | 27000000 |
| Operational Revenue | 28000000 |
| Total Asset | 400000000 |

| company A4 | |
|---|---|
| Date | Steel Price |
| Operational Cost | 10600000 |
| Operational Revenue | 11615000 |
| Total Asset | 150140000 |

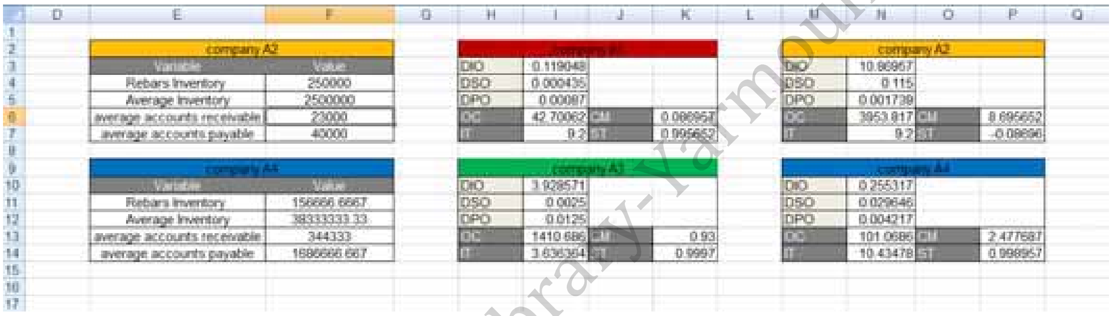
| company A1 | |
|---|---|
| OC/AS | 85.78431 |
| OR/AS | 93.95425 |
| ROA | 0.006667 |
| ROS | 0.086957 |

| company A2 | |
|---|---|
| OC/AS | 1.815541 |
| OR/AS | 2.087872 |
| ROA | 0.107143 |
| ROS | 0.130435 |

| company A3 | |
|---|---|
| OC/AS | 2700 |
| OR/AS | 2800 |
| ROA | 0.0025 |
| ROS | 0.035714 |

| company A4 | |
|---|---|
| OC/AS | 731.0345 |
| OR/AS | 801.0345 |
| ROA | 0.00676 |
| ROS | 0.087387 |

Figure (7-4) Finance F3 financial data entry



| company A2 | |
|---|---|
| Variable | Value |
| Rebars Inventory | 250000 |
| Average Inventory | 2500000 |
| average accounts receivable | 23000 |
| average accounts payable | 40000 |

| company A4 | |
|---|---|
| Variable | Value |
| Rebars Inventory | 156666.6667 |
| Average Inventory | 38333333.33 |
| average accounts receivable | 344333 |
| average accounts payable | 1686666.667 |

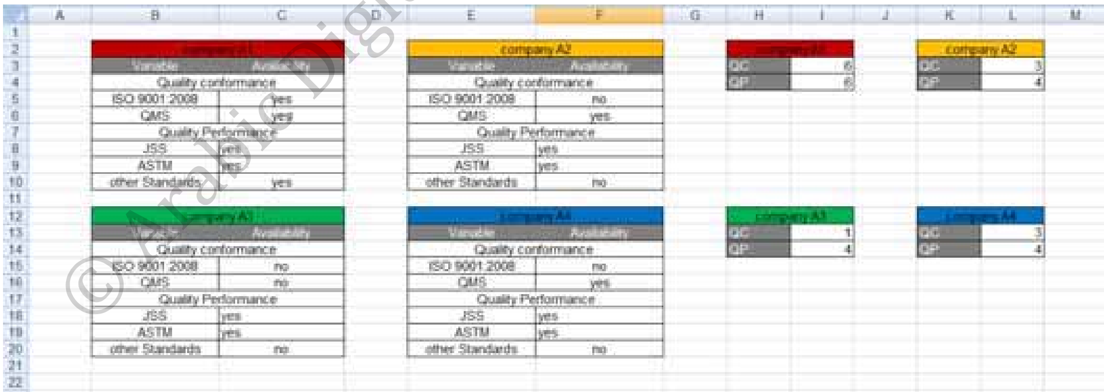
| company A1 | | | |
|---|---|---|---|
| DIO | 0.119048 | | |
| DSO | 0.000435 | | |
| DPO | 0.00087 | | |
| OC | 42.70062 | CM | 0.086957 |
| IT | 9.2 | ST | 0.995652 |

| company A2 | | | |
|---|---|---|---|
| DIO | 10.86957 | | |
| DSO | 0.115 | | |
| DPO | 0.001739 | | |
| OC | 3953.817 | CM | 8.695652 |
| IT | 9.2 | ST | -0.08696 |

| company A3 | | | |
|---|---|---|---|
| DIO | 3.928571 | | |
| DSO | 0.0025 | | |
| DPO | 0.0125 | | |
| OC | 1410.686 | CM | 0.93 |
| IT | 3.636364 | ST | 0.9997 |

| company A4 | | | |
|---|---|---|---|
| DIO | 0.255317 | | |
| DSO | 0.029646 | | |
| DPO | 0.004217 | | |
| OC | 101.0686 | CM | 2.477687 |
| IT | 10.43478 | ST | 0.998957 |

Figure (7-5) Inventory F5 inventory Data entry



| company A1 | |
|---|---|
| Variable | Availability |
| Quality conformance | |
| ISO 9001 2008 | yes |
| QMS | yes |
| Quality Performance | |
| JSS | yes |
| ASTM | yes |
| other Standards | yes |

| company A2 | |
|---|---|
| Variable | Availability |
| Quality conformance | |
| ISO 9001 2008 | no |
| QMS | yes |
| Quality Performance | |
| JSS | yes |
| ASTM | yes |
| other Standards | no |

| company A3 | |
|---|---|
| Variable | Availability |
| Quality conformance | |
| ISO 9001 2008 | no |
| QMS | no |
| Quality Performance | |
| JSS | yes |
| ASTM | yes |
| other Standards | no |

| company A4 | |
|---|---|
| Variable | Availability |
| Quality conformance | |
| ISO 9001 2008 | no |
| QMS | yes |
| Quality Performance | |
| JSS | yes |
| ASTM | yes |
| other Standards | no |

| company A1 | |
|---|---|
| QC | 6 |
| QP | 6 |

| company A2 | |
|---|---|
| QC | 3 |
| QP | 4 |

| company A3 | |
|---|---|
| QC | 1 |
| QP | 4 |

| company A4 | |
|---|---|
| QC | 3 |
| QP | 4 |

Figure (7-6) Questionnaire Q3 Quality Data entry



| [illegible] | |
|---|---|
| Variable | Availability |
| Product Mix | |
| Steel Section | |
| Diameter 8mm-12mm | yes |
| Diameter 16mm-32mm | yes |
| Length 6m-15m | yes |
| Flat Bars | yes |
| Square Bars | yes |
| Plane round Bars | yes |

| company A2 | |
|---|---|
| Variable | Availability |
| Product Mix | |
| Steel Section | |
| Diameter 8mm-12mm | yes |
| Diameter 16mm-32mm | yes |
| Length 6m-15m | yes |
| Flat Bars | yes |
| Square Bars | yes |
| Plane round Bars | yes |

| company A3 | |
|---|---|
| Variable | Availability |
| Product Mix | |
| Steel Section | |
| Diameter 8mm-12mm | yes |
| Diameter 16mm-32mm | yes |
| Length 6m-15m | no |
| Flat Bars | no |
| Square Bars | no |
| Plane round Bars | no |
| Engineering Section | no |

| company A4 | |
|---|---|
| Variable | Availability |
| Product Mix | |
| Steel Section | |
| Diameter 8mm-12mm | yes |
| Diameter 16mm-32mm | yes |
| Length 6m-15m | yes |
| Flat Bars | no |
| Square Bars | no |
| Plane round Bars | no |
| Engineering Section | no |

| [illegible] | |
|---|---|
| PM | 6 |

| company A2 | |
|---|---|
| PM | 6 |

| company A3 | |
|---|---|
| PM | 2 |

| company A4 | |
|---|---|
| PM | 3 |

Figure (7-7) Questionnaire Q5 Inventory Data entry

3- In each data entry sheet, there is 4 box's labeled by red, yellow, green, and blue colors, that indicates the companies, each data entry label represents customized data which taken from: sales reports (F1 and F2), financial statements (F4), financial/Inventory reports (F5), Quality conformance/Performance certificate (Q3), and products available (Q5).

4- After you fill the data in each data entry sheets, the capabilities and the taxons will be calculated automatically and reappeared on the taxons sheet, the capability for each company alone and their tentative taxons is presented.

Moreover, on the chart sheet, chart will be appears to represents the capabilities for each company (*see figure (7-8)*).

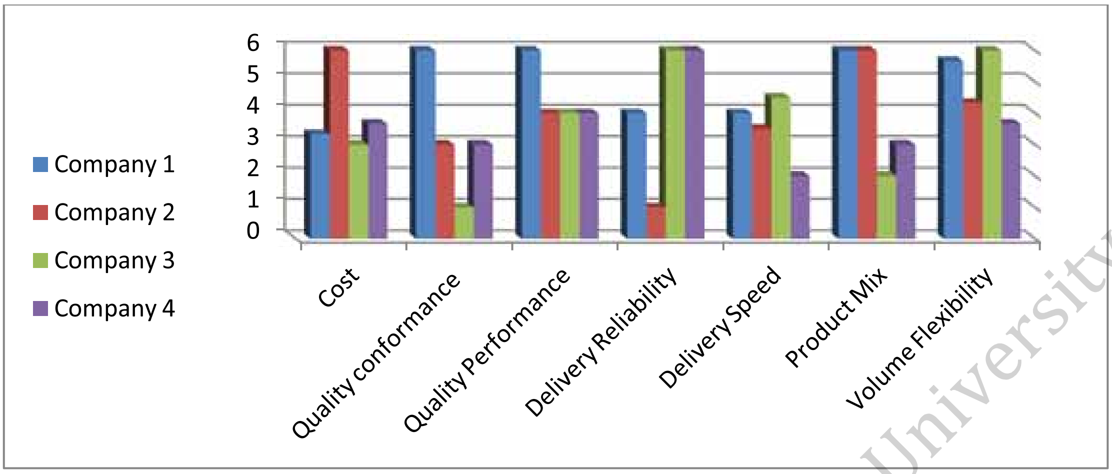



Figure (7-8) DSS companies capabilities comparisons

## 7-5 Summary

The tentative taxonomies of manufacturing strategies model were used to develop a decision support system, the system was developed to give the productions/operations manager within the Jordanian Iron and Steel corporations a decisions tool, the DSS includes eight worksheets were labeled according to data entry, data which taken from: sales reports, financial statements, Inventory Statistics, Quality conformance/Performance certificate, and the products can be purchased from the Steelmaker. The output indicate the companies relative capability performance and the predicted taxons, where the productions/operations managers can addressed his/her Iron and Steel corporation relative status, then he/she can enact to enhance his/her companies' performance.

# Chapter 8

## Discussions

Chapter 8

# Discussions

## 8-1 Introduction

The Purpose of this chapter is to discuss the realized taxonomies of manufacturing strategies according to tentative, sustained and emerged definitions. The discussion starts with explaining the manufacturing strategy variables results.

The researcher discuses the competitive capabilities needed to realize the sustained or emerged manufacturing strategic groups within the Jordanian Iron and Steel corporations.

Accordingly, this chapter discusses how the Iron and Steel corporations' decisions are affected by manufacturing strategic groups. Moreover, the discussion will verify the performance indicators which have significant impact on the formed strategic groups.

## 8-2 Manufacturing Strategy Variables

The manufacturing strategy variables according to pervious literature (*see chapter 3*) can be categorized into three main groups: competitive capabilities (competitive priorities), decisions (Actions) and performance indicators. These variables were realized for the Iron and Steel corporations over the period 2008-2012.

Many previous studies (e.g. Miller and Roth 1994; Kathoria 2000; Frohlich and Dixon 2001; Zhao et al. 2006) state that; these variables are mutually exclusive, even some of these variable are highly correlated with each of other (*see chapter 5*).

The majority of previous literature created the taxonomies by using capabilities as variables. However, some studies used decisions and performance indicators used as variables for creating the taxonomies. In this research the manufacturing capabilities are used as grouping factor, decisions and performance indicators are treated as dependent variables to justify the effectiveness of formulated tentative, sustained and emerged taxonomies.

### 8-2-1 Manufacturing capabilities

Table (6-3) shows significant positive T-value for all capabilities, this indicate that Iron and Steel corporations utilize the high significant level of capabilities (*see chapter 6 table* 6-3), some variables are highly correlated with each of other while others aren't (*see appendix A*), this result indicates that Jordanian Steelmakers tend to construct their own taxons, whether these Steelmakers imitate each others, react to industrial and external environment, seeking survival or pursuing competitive advantage. These approaches realized according to cluster analysis.

However, the scores of competitive capabilities achieved by Iron and Steel industry are mainly within the average. Only Quality control traits are above the average since most Jordanian Steelmakers using same performance standards which is the JSS and the ASTM, and confirmed to similar programs (such as ISO 9001:2008), which are consider within best practices

all over the world. The strategic operating procedure is similar with the QMS practices. As mention in (*table 6-2*) there is three companies earned ISO 9001:2008 within the study sample for the period 2008-2012 were included within the study sample.

### 8-2-2 Manufacturing Decisions

Also Iron and Steel manufacturers have similar decision procedures, which led to have average delivery and flexibility performance even these practices are significant in practice. According to the researcher experience only few Steelmakers are using enterprise recourse planning technique. While most of the Iron and Steel corporations offers onsite purchasing which will increases the delivery and flexibility traits, also affected the cost variable.

After the Global economic crisis, Jordanian Iron and Steel corporations in particular made agreement with Amman chamber of industry to bulletin new guidance for steel prices locally (Al-Rai, 2008). The marginal difference between steel rebar prices still significant, but ranges exist because Jordanian Steelmakers targeting different customers in the same market (e.g. this argument was suggested when the researcher interview sales engineer of the sample; one of the interviewee emphasized that his company is targeting major contractors so the price is not within their focus; on the other hand other Steelmaker executive manager emphasized that; the price is very important so they would to tolerate some loses to satisfy their customer even they were dealing with steel entrepreneur, other financial manger emphasized that; some Steelmakers play broker games to sink the market).

According to Table (6-4) results emphasized that Iron and Steel corporations had significant structural decisions during the period 2008-2012. These decisions are: the capacity utilization, supply chain vertical integration, location and facility layout integration.

Referring to sample most of Iron and Steel corporations unable to utilize more than 70% of its total capacity during the past 5 years (*see appendix C*), meanwhile achieving the highest level of capacity utilization will enable the Steelmakers to reach higher level of economies of scale.

**8-2-3 Manufacturing performance indicators**

Backing to year 2008 where many observers indicate it as diversity year for Iron and Steel industry in Jordan. Two Steelmakers acquired smelters in hope to decrease the billet cost, many argument have been made: questioning whether these decision choices where valid and feasible or not, beside upstream integration have been made Iron and Steel companies offered complementary products and services along with steel rebar products, in order to achieve downstream practices.

Iron and Steel corporations are scatter within the Hashemite Kingdom of Jordan, the sample include Steelmaker plants in: Amman, Zarqa, and Mafraq. Different location makes significant difference between them, the significant difference shown in Table (6-4) which this reflects these facts.

Finally, according to decisions have been made by Jordanian Iron and Steel corporations regarding facility layout design is examined through the layout between the Rolling Mill Route and Electrical Arc Furnace (EAF)

Route, Steelmakers have been classified accordingly into three groups: companies with consolidated line where the Rolling Mill and EAF are separated with two different layouts, companies with combined facility layout where both Rolling Mill and EAF are within the same layout, and companies that don't have EAF (*see appendix A*).

Many local observers consider the period 2008-2012 was critical according to external, industrial, and internal environmental changes emerged to the region. These environments influenced to the local Steelmakers, regarding the industrial environment some the companies left the competition, where other extraneous enter the steel market. The external environment was upsetting because the influence of global and the local financial crisis. The internal environment wasn't either stable (e.g. an interview with financial manger reports that his company is thinking seriously for layoffs and downsizing to deal with their compensations). These factors make most of Iron and Steel companies have average performance, but some companies outperform others and take opportunity by increasing their production, while others prefer to wait and see what will happen regarding the billet international price; these practices increase both relative market share and sale growth for some companies others suffered by decay both of these performance indicators.

On the other hand, Return on Sales and Return on Asset were influenced by emergent pricing policy which was affected by emergent cost reduction strategy, as a result from emergent taxonomies. Also some companies prefer to shoulder the losses by decreasing there capital investment to satisfy their stakeholders and other minor shareholders.

## 8-3 Tentative Manufacturing Strategy Groups

Table (6-6) indicates that; there were three manufacturing capabilities variable succeeded in achieving the tentative manufacturing strategic groups. These manufacturing capabilities variables were: quality conformance, quality performance, and product mix.

Accordingly, The manufacturing strategic groups developed were the low emphasizers, lean production and differentiators. 18 observations were rated among differentiators this indicates many Steelmaker are trying to emerge different capabilities and establish generic strategy to outperform other competitors, but they were unable to sustained these practices, while the other 15 observations where within lean production group which indicates some Steelmakers to be agile during this critical period, the last two observations within the low emphasizers indicate the Steelmakers was straggling in the bottom against its competitors.

Table (8-1) shows the manufacturing capabilities within low emphsizers, lean production, and differentiators. low emphsizers has low capabilities performance where the highest ranks belong to the cost, which means the Steelmaker tends to lower it cost as trade-off to the other variable. However this practice led the company to the bottom against its competitors. The grouping factors: quality conformance, quality performance and product mix, which related to customer satisfactions where in the bottom.

Lean production group where following the customer needs except the cost, the trade-offs between these variables is hard, as the levels of quality goes high the cost will be increased, also the economics of scope and economics of scale are highly negatively correlated.

This led us to the main cluster which is the differentiator, this manufacturing strategic group scarifies the quality conformance in order to satisfy both cost and the other capabilities including the quality performance, the quality management system can be highly costing and making boundaries to achieve competitive advantage. Think out of the box which the Iron and Steel corporations really needs, conventional practices are not healthy for spontaneous daily based decision, creativity and innovations is essential on the operational strategic level.

Table (8-1) the manufacturing capabilities ranks within tentative groups

| capability | low emphsizers | lean production | Differentiators |
|---|---|---|---|
| Cost | 1 | 5 | 5 |
| Quality Conformance | 6 | 1 | 7 |
| Quality Performance | 6 | 2 | 1 |
| Delivery Reliability | 3 | 4 | 4 |
| Delivery Speed | 3 | 7 | 6 |
| Product Mix | 3 | 3 | 2 |
| Volume Flexibility | 2 | 6 | 3 |

The research analyze the tentative manufacturing strategic group with decision made by Iron and Steel corporations during the period 2008 to 2012 (*see table 6-8*) using Kruskal Wallis with the SPSS, the research also analyzed the performance according to significant industrial groups for the

same period (*see table 6-9* using Kruskal Wallis analysis of variance technique within the SPSS package.

The Table (6-8) shows manufacturing strategic group has been affected by decision made by Jordan Iron and Steel corporations for the period 2008-2012, low emphasizers, lean production and differentiators are formulated by decision made related to utilization, upstream integration and downstream integration. These traits are related to operations decisions, so there influence on strategic groups on daily basis will be manifest, and this the goal from this research, to show to what extent the operational decision effects the manufacturing strategic groups.

However, Location and Facility layout design related decisions are made for the long-run and analogs with oversight strategies, so no significant affect was reflected by these decisions on the manufacturing strategic groups.

Table (6-8) shows that the performance indicators are not reflected significantly by the manufacturing strategic group except for the relative market share indicators. As mentioned before regarding the industrial environment, some local Steelmakers march out from the steel marker, while others were entered. This environment affects relative market share since some steelmakers' groups' tries to take advantages, while others preferred to wait until see what will happen. However, most Iron and Steel corporations suffered from the global financial crisis and the local economic recession, most of these Steelmakers emerge their strategies to survive even the large companies such as Jordan Steel, not attempt to achieve superior performance.

## 8-4 Sustained Manufacturing Strategy Groups

The sustained taxonomies to exam the Steelmakers capabilities are shown in table (6-10) which are affected by long-term decisions made by Jordanian Steelmakers within the period 2008-2012.

The results indicated that; three sustained manufacturing capabilities were responsible for clustering Iron and Steel corporations into three strategic categories; the capabilities are: quality conformance, product mix and volume flexibility, these capabilities differ from tentative taxon realized in the past section (*see Table 8-2*).

Table (8-2) the manufacturing capabilities ranks within Sustained groups

| capability | low emphsizers | lean production | Differentiators |
|---|---|---|---|
| Cost | 4 | 4 | 6 |
| Quality Conformance | 7 | 1 | 1 |
| Quality Performance | 1 | 1 | 2 |
| Delivery Reliability | 5 | 6 | 3 |
| Delivery Speed | 3 | 5 | 4 |
| Product Mix | 6 | 1 | 7 |
| Volume Flexibility | 2 | 7 | 4 |

While the Cost was within the middle rank, the low emphasizers tend to satisfy the steel market local needs, Steelmakers tried to analogs local seasonality needs and meet there quality standards at lowest cost. The differentiators were the company tried to make generic strategy, the lean

production are the pioneer Steelmaker which can to enact smoothly with the changed industrial and external environment with the study period.

The first capability which is quality conformance is achieved through quality management program, Table (6-2) showed that there are three companies achieved QMS program (ISO 9001:2008) with the study period, in order to sustain the QMS programs the higher management levels commitment.

Moreover, volume flexibility is realized according to the researcher experience by adopting level demand strategy, accordingly the Steelmakers adopted continuous process layout and the process technology is Rolling Mills plants, these Steelmakers follow make to stock as inventory management strategic choice to lower their startup and setup costs which considered very high compared with other industries (Department of statistics, 2006).

Jordan Iron and Steel corporations utilized fully-automated Rolling Mills processes which enable them to producing variety of products needed for the local market, but the capabilities for production line vary from manufacturing group to another; (e.g. the researcher interviewed some plant manager and they indicates that process cycle to produce all product takes 3 months, anther plant manager within major Steelmaker continued that; the factory able to fabricate all products line within a month, even though the second Steelmaker is capable to produce more product line than the other Steelmaker).

Under the hardship situation emerged by the global financial crisis and the Jordanian economic recession, the researcher found that Jordanian

Steelmakers are suffering from keeping themselves within the average performance; this leads to conclude that; most of Jordanian Steelmakers within the sample in particular within the period 2008-2012, are hoping to survive, and the achievements of competitive advantages is unreachable.

## 8-5 Emergent Manufacturing Strategy Groups

Local Jordanian recession in 2010 as mentioned in the literature review forced many Jordanian manufacturing organizations to emerge new strategy to survive. In our scope Steel industries also suffered from this circumstances even the Steel Company (Alanbat, 2013), but even through and some new investors enter the steel market also and may in also (Arabsteel.com, 2013), also that some Steelmakers within the sample start implement vertical integration by constructing and acquiring electrical arc furnace smelters (*see table 6-2*).

The Results conclude that Iron and Steel corporations enact within three different manufacturing capabilities groups, which were different from tentative and sustained industrial groups. The groups emerged are: the low emphasizers, the integrators and the reactors.

The major capability is the cost, since the billet price reached very expensive rate in 2008 (Al-Rai, 2008). This enthusiast many Steelmakers to acquire upstream integration by establishing electrical arc furnace, this technology suits the local Jordanian atmosphere regardless its environmental

issues which forced by the government to pay extra fees for metallic scrap which resolved eventually in 2012 (Alrai, 2010; 2012).

Table (8-3) the manufacturing capabilities ranks within emerged groups

| capability | low emphsizers | lean production | Differentiators |
|---|---|---|---|
| Cost | 5 | 1 | 3 |
| Quality Conformance | 6 | 5 | 6 |
| Quality Performance | 3 | 5 | 6 |
| Delivery Reliability | 4 | 2 | 3 |
| Delivery Speed | 1 | 3 | 3 |
| Product Mix | 6 | 5 | 1 |
| Volume Flexibility | 1 | 4 | 2 |



Table (8-3) showed that Jordanian Steelmaker groups has no systemic to order there capabilities, they were trying to decrease the cost using different techniques, the reactor found saving the cost can be achieved via flexibility, by producing the highest production level in summer and minimum in the winter, the integrators achieved their cost leadership strategy by simply cutting the cost, while low emphasizers has no justified tactics.

The results conclude that the emerged strategic patterns have no significant influenced by the decisions emerged in that period, from researcher unassuming experience, even with acquiring EAF, the competition between Steelmakers and Steel traders are not fair, since the government is tardy to enact laws that protect our local industries in general and Iron and

Steel sector in particular, the influence of external factor will be devastating, even with critical emerging decisions.

The results showed that Iron and Steel corporations' performance isn't affected significantly by the emerged strategic pattern which formed by cost capability. This is a negative signs, so Iron and Steel corporations should lock for new technologies and invest in new innovative and creative ideas. Therefore, Iron and Steel corporations in Jordan shouldn't relay on conventional practices. Methods such modern management practices which depend on quantitative decisions, systematic and constituted practices, and contingency approach.

## 8-6 Summary

According to tentative, sustained and emergent results, the manufacturing strategic groups were differ according to point of prospective within the Jordanian Iron and Steel corporations for the period 2008-2012. Tentative manufacturing strategy taxonomies are formalized by four significant capabilities, while sustained manufacturing strategy taxonomies were formed by three significant manufacturing capabilities, both tentative and sustained group share the same manufacturing strategic groups. However, only one manufacturing capabilities was responsible for emergent taxonomies of manufacturing strategy which was the cost.

As we are reaching to end of our story, Iron and Steel corporations tried to imitate each of other capabilities, forgotten the core competitive criteria where any anther industry or service can achieve superior performance which grantees the competitive advantages.

The Innovations and Creative practice are required for this century; organizations should listen to its stakeholders, whether they were engineers, salesmen, or even handlers. Many creative practices come from unassuming persons where the history is full of their stories.

Also Modern Management which depends on Quantitative, Systematic, and contingency approaches are needed for local industry in general and fro the Iron and Steel corporations in particular.

# Chapter 9

## Conclusions, Implementations and Future Research

Chapter 9

# Conclusions, Implementations and Future Research

## 9-1 Introduction

Conclusion of the research is presented in this chapter, the chapter is separated into three sections: the conclusions, the theoretical, and the practical implementation, starting from the conclusion were it will summaries the research project, then the conclusion will estimate the academic implementation, finalized on how Iron and Steel corporations in Jordan could formulate the taxonomies of manufacturing strategies patterns (taxon prediction models), which promises for best practices.

## 9-2 Conclusions

The Result showed that Iron and Steel corporations formulated tentative, sustained and emergent manufacturing strategic groups, which were differ according to point of prospective for the period 2008-2012.

Tentative manufacturing strategy taxonomies formulated by three significant capabilities, there capabilities were realized by operational actions which made by COO or his representative, the tentative taxonomies reported are three clusters, while sustained manufacturing strategy groups were formed by the three significant manufacturing capabilities, the corporations are categorized into three manufacturing strategic groups. However, only one manufacturing capability is responsible for achieving the three emergent manufacturing groups this capability is the cost (*see table 6-15*).

### 9-2-1 Tentative Taxonomies of Manufacturing Capabilities

The tentative taxons within the Jordanian Iron and Steel corporations were: the low emphasizers, lean production, and differentiators. Many Jordanian Steelmakers preferred to achieve differentiators' strategic group, since steel industry has many needs to keep up with the competitions, but these companies need to think creatively. Beside the quality aspect which was distinctive competencies, Jordanian Steelmakers needs to innovate broader line of products to keep their competitive advantage, while increasing their relative market share is out of reach, the Iron and Steel corporations need to enter new market to enhance their overall performance.

### 9-2-2 Sustained Taxonomies of Manufacturing Strategy

Many operations strategy theorist emphasize that through competitive capability, the companies can achieve competencies, however through sustaining these capabilities the organization can achieve core competencies (Prahalad and Hamel, 1990). This will lead eventually to superior performance.

The sustainable taxons were unable to achieve superior performance for Jordanian Iron and Steel corporations within the period (2008-2012). This leads the research to conclude that Jordanian Iron and Steel corporations suffer from conventional practice, this industry need good manufacturing practices and modern management practices to be implemented.

### 9-2-3 Emergent Taxonomies of Manufacturing Strategy

The Iron and Steel industry is highly sensitive to the external environment, emergent decision are the most critical decisions can be made, but Jordanian Iron and Steel corporations need not to have decision regarding only one aspect. Iron and Steel decision-maker should analyze using tool such as SWOT and other techniques.

## 9-3 Conceptual Applications

**Developed proposed Taxonomies of Manufacturing Strategy**

The research proposed three taxonomies to deal with different dilemma can face Iron and Steel corporations, tentative taxonomies of manufacturing strategy is introduced to deal with the daily basis routine, while sustained taxonomies of manufacturing strategy were introduced to help researchers, decision-makers and superintendents to realized how to sustained the competitive advantage. The emerged taxonomies of manufacturing strategy presents the decisions made by the Steelmakers superintendents, and to what extent they were capable to deal with the global crises and the Jordanian recession within the period (2008-2012).

**Developed Practical Taxonomies of Manufacturing Strategy**

The modern management emphasizes the use of quantitative decision; this research presents taxons by using published facts instead of self-reporting methodology. These taxons represent the reality.

Using standard deviation ranking method, the Jordanian Iron and Steel corporations can use this technique to compare their manufacturing strategies facts: competitive capability, actions, and performance.

The research presents DSS software, which is helpful for productions/operations decision makers to realize their manufacturing strategy.

## 9-4 Practical Applications

In this section different applications were recommended for Iron and Steel corporations in Jordan, these applications were developed according to the analysis results and the discussion. The applications for Iron and Steel corporations were recommended for each tentative, sustained, and emerged definition.

**Applications for tentative manufacturing strategic decisions**

Jordanian Iron and Steel corporations facing continuous daily challenges, this provokes Steelmakers to react swiftly with these situations.

**Applications for sustained manufacturing strategic decisions**

Jordanian Iron and Steel corporations should stabilize its manufacturing capabilities to achieve core competencies which led to competitive advantage.

**Applications for emerged manufacturing strategic decisions**

Jordanian Iron and Steel corporations should be ready for future, talent executive with entrepreneur oversights who can tolerate responsibility can

manage to realize emergent decisions which will lead to significant performance and competitive advantage.

## 9-5 Future Research

The taxonomies of manufacturing strategy prediction models developed reflect the Iron and Steel corporations manufacturing strategic groups in Jordan which were reported for seven major Steelmakers, so the prediction models developed in this research project are still indicative models. Their external validity could be examined by conducting further researchers in other developing countries that have larger sample size to have more valid quantitative facts, so high level statistical approaches as regression analysis could be used in combination with the methodology developed in this research project to have more accurate prediction models. we can't know the future, but with the information we have in our hand we can anticipate the future and prepare ourselves, the prediction models is our time-machine.

The future for Jordanian Iron and Steel industry is vaporous, but still promising, the manpower within this industry are well qualified, the potentials for this industry still unlimited, this industry is core for our nation economics we can abandon it, the taxonomies of manufacturing strategy in Jordan could be a guide for the majority of similar manufacturing industries, these industries should focus on its internal strength, give chance to its unseen stakeholders, which can bring creativity and innovations; not only by introducing new products, but within anther critical logistic areas such as maintenance, human resource management, production and inventory management on the operational level, also manufacturing sectors should

emphasize on modern management practices: build their decision according to quantitative facts not on qualitative judgment, good manufacturing practices should be adopted to construct institute within the firms, and recruit talent executive who have oversights to enact with emergent situations.

Our manufacturing sector suffered from both global economic crisis and the local recession, the Iron and Steel industries influenced by this hardship, then the prediction models according to sustained and emergent definitions notice the reflection which indicated by insignificant performance react to the formation of manufacturing groups. The operational decisions which identified the tentative taxonomies of manufacturing strategy were sensitive for both decisions and performance achieve via these groups.

The standard deviation ranking method was useful technique, used to unify the continuous facts; on the other hand some limitations according to emergent definitions could be handled in the future research.

As a result of small sample of Iron and Industry surveyed in this research project it was impossible to investigat the impact of manufacturing sector characteristics on the adopted taxonomies, so in future some anther competitive capabilities (such as Design flexibility (innovation), and after sales service), infrastructural decisions: (such as workforce, production planning, and inventory management) , performance indicators: (such as ROI, and ROE), social responsibility, and environmental actions should be taken in considerations in the future researches.

**References:**


1. Al-Ghad, (2012), "Industry Agree to Import 27,000 steel tons on 9 months"; (31/10/2012).
2. Al-Mufleh A, (2010), *"Steel Sector Report"*, Export and Finance Bank, Jordan.
3. Almuharrir, (2010), "Government adopts the mechanism of Iraqi scrap import at all border posts", [online], http://www.almuharrir.net/local/53-2011-01-24-05-25-28/24247-2012-05-21-19-56-50.html, [Accessed at 16th March 2013].
4. Al-Rai, (2010), "increased production costs behind the rise in steel prices Jordanian market"; (5/4/2010).
5. Al-Rai, (2010)," Iron factories in Jordan predicted closure", (13/5/2010).
6. Al-Rai, (2012), "Iron scraps exempt from sales tax"; (27/12/2012).
7. Al-Rai, (2012), "Jordan Steel is working on expanding its plant to enter the markets of the Gulf"; (13/7/2012).
8. Al-Rai, (2013), "Jordan protection fees imposed on imports of steel"; (13/6/2013).
9. Al-Rai, (2013), "Jordan Steel... Signs of collapse"; (16/5/2013).
10. Altrichter, H., Feldman, A., Posch, P. & Somekh, B., (2008), "Teachers investigate their work; An introduction to action research across the professions", Rutledge. p. 147. (2nd edition).
11. Aranda, D., "(2002), "Relationship between operations strategy and size in engineering consulting firms, International Journal of Service Industry Management, Vol. 13, No. 3/4.
12. Bozarth, C. and Mcdermott, C., (1998), "Configurations in manufacturing strategy: a review and directions for future research", Journal of Operations Management, Vol. 16 No. 4, pp. 427-39.
13. Bülbül, H, (2011), "A taxonomy of manufacturing strategies: A study of the Turkish automotive industry", African Journal of Business Management Vol.5 (6), pp. 2322-2335, 18 March, 2011
14. Burns t. and Stalker g. m., (1961), "the management of innovation", London tavistock.
15. Department of statistics, *"Annual Report"*, Jordan, (2006-2011).

16. Department of statistics, (2010), "SUMMARY OF THE ANNUAL INDUSTRIAL STATISTIC FOR LARGE ESTABLISHMENTS (Value of production, wages & benefits)", Jordan, (2005 - 2009).
17. Director of industrial development, *" Annual Industrial Reports"*, Department of Industrial policy, Jordan Ministry of industry and trade, Jordan, (2006-2011).
18. Doty, D.H., and Glick, W.H., (1994), "Typologies as a unique form of theory building: Towards improved understanding and modeling", Academy of Management Review, 19, 230-251.
19. Doty, D.H., and Glick, W.H., (1998), "Common methods bias: Does common methods variance really bias results", Organizational Research Methods, 374-406.
20. Frohlich, M. and Dixon, J.R., (2006), "A taxonomy of manufacturing strategies: revisited", Journal of Operations Management, Vol. 19 No. 5, pp. 541-558.
21. Frohlich, M. and Dixon, J.R., (2006), "Reflections on replication in OM research", Journal of Operations Management, Vol. 24, pp. 865-867.
22. Global Research, (2009), *"Jordan Steel Investing Backward"*, Global Investment House, Jordan, (Jan, 2009).
23. Hatch M J., (1997), "Organization Theory modern symbolic and post Modern perspective", oxford university press, Inc New Jersey.
24. Hausman, H., Montgomery, B., (1997), "Optimal Production Operations Sequencing", IIE Transactions, Vol. 29.
25. Hausman, H., Montgomery, B., Roth, V., (2002), "Exploring the Impact of Marketing and Manufacturing Strategies, Conflict, and Morale on Business Performance", STANFORD university paper.
26. Huete, L. and A. V. Roth, (1987), "Linking Manufacturing Capabilities with SBU Strategic Directions," Procedures Of the 1987 Decision Sciences Institute.
27. Jordan Times, (2012),"Jordan to host World Economic Forum in 2013"; (18/12/2012).

28. Kanungo, & et al., (2002), "An Efficient k-Means Clustering Algorithm: Analysis and Implementation", IEEE, Vol. 24, No. 7, JULY 2002
29. Kathuria, R., (2000), "Competitive priorities and managerial performance: a taxonomy of small manufacturers", Journal of Operations Management, Vol. 18 No. 6, pp. 627-641.
30. Ketchen, D. and Shook, C., (1996),"The application of cluster analysis in strategic management research: an analysis and critique", Strategic Management Journal, Vol. 17, pp. 441-458.
31. Kotha, S. and Orne, D., (1989), "Generic manufacturing strategies: a conceptual synthesis", Strategic Management Journal, Vol. 10, pp. 211-31.
32. Martin-Pena, M.L. and Diaz-Garrido, E. (2008), "A taxonomy of manufacturing strategies in Spanish companies", International Journal of Operations & Production Management, Vol. 28 No. 5, pp. 455-477.
33. Metal Bulletin Focus Supplements, "*Middle east Steel 2012",* www.salzgitter-mannesmann-international.com
34. Metal Expert, (2010), "Jordan Steel increases its production capacity by March2012",[online].http://www.arabsteel.info/TOTAL/long_news_Total.asp?ID=1611, [accessed at 19th January 2013].
35. Meyer, A. and Picke, B., (1996), "Falling behind in innovation. The 1996 report on the European manufacturing futures survey", INSEAD Working Paper, Fontainebleau.
36. Meyer, A., (1992), "An empirical investigation of manufacturing strategies in European industry", in Voss, C.A. (Ed.), Manufacturing Strategy, Process and Content, Chapman & Hall, London, pp. 221-38.
37. Migdadi Y., (2010), "Identifying the best practices in traditional and electronic banking operations strategies in developing economics (the case of Jordan)", Bradford submitted thesis.
38. Miles, R. E. and C. C. Snow, (1978), "Organizational Strategy, Structure, and Process", McGraw-Hill, New York.
39. Miller, J. and Roth, A., (1994), "A taxonomy of manufacturing strategies", Management Science, Vol. 40 No. 3, pp. 285-304.

40. Ministry of Tourism and Antiquates of Jordan, (2010), [online], http://www.tourism.jo/en/, [Accessed at 13th March 2013].
41. Ministry of Labour of Jordan (2011), [online], http://www.mol.gov.jo/default.aspx?tabid=175, [Accessed at 13th March 2013].
42. Mintzberg & et al,. (2006), "Strategy Bites Back: its for More and Less than you Ever Imagined", Prentice Hall.
43. Mintzberg, H and J. A. Waters., (1984), "Tracking strategy in an entrepreneurial firm", Academy of management Journal, pp. 465-499.
44. Mintzberg, H., & Quinn, J., (1996),"The Strategy Process: Concepts, Contexts& Cases", Third Edition, New Jersey.
45. Neely, & et al., (1994), "Realizing Strategy through Measurement" International Journal of Operations & Production Management, Vol. 14 No. 3, 1994.
46. Porter, M., (1980), "Competitive Strategy: Techniques for analysis competitors", Free Press, New York.
47. Porter, M.E., (2008), "The Five Competitive Forces That Shape Strategy", Harvard Business Review.
48. Skinner, W., (1969), "Manufacturing the missing link in corporate strategy", Harvard Business Review, Vol. 47 No. 3, pp. 136-145.
49. Sum, C., Kow, L. and Chen, C. (2004), "A taxonomy of operations strategies of high performing small and medium enterprises in Singapore", International Journal of Operations & Production Management, Vol. 24 No. 3, pp. 321-345.
50. The Higher committee Of the Jordanian National Opposition Political Parties, (2010), "*Results and impacts of the financial and economic crisis World on the Jordanian economy*", (Amman, 20/3/2010), 'The Jordanian National Economic Conference'.
51. University of Texas Libraries, (2004), [online], https://www.lib.utexas.edu/, [Accessed at 13th March 2013].
52. Wikipedia the free encyclopedia, (2012), *Jordan*, [online]. http://en.wikipedia.org/wiki/Jordan, [Accessed at 13th March 2013].
53. Zhao, X., Sum, C., Qi Y, Zhang H, Lee TS, (2006), "A taxonomy of manufacturing strategies in China", J. Operations. Managements. 24(5): 621–636.

## Appendices A

## A2- Taxonomies of manufacturing strategy previous studies

| Author | Sectors | Taxons | Variables | Methodology |
|---|---|---|---|---|
| **Miller and Roth (1994)** | 164 American manufacturers | caretakers, marketeers, innovators | 11 competitive priorities | Self-Reporting |
| **Kathuria (2000)** | 99 American manufacturers | starters, efficient conformers, speedy conformers, do all | Four competitive Priorities | Self-Reporting |
| **Sweeney and Szwejczewski (1996, 2000)** | 138 UK engineering companies | variant producers, innovators, mass producers, mass customizers | Six competitive Priorities | Self-Reporting |
| **Frohlich and Dixon (2001)** | 207 American Manufacturers (1994); 703 global manufacturers (1998) | caretakers, designers, specialists | 11 competitive capabilities (replicates Miller and Roth) | Self-Reporting |
| **Christiansen et al. (2003)** | 63 Danish Manufacturers (2001) | low pricers, quality deliverers, speedy deliverers, aesthetic designers | Nine competitive Priorities | Self-Reporting |
| **Ketokivi and Schroeder (2004)** | 164 manufacturing plants five large industrialized | 2caretaker clusters, marketeers, generalists | Eight manufacturing priorities | Self-Reporting |

| | | | | |
|---|---|---|---|---|
| | countries (1994-1997) | | | |
| Author | Sectors | Taxons | Variables | Methodology |
| **Sum et al. (2004)** | 43 high performing manufacturing SMEs, Singapore | All-rounders, efficient innovators and differentiators | 11 operations priorities (replicates Miller and Roth) | Self-Reporting |
| **Zhao et al. (2006)** | 175 manufacturing companies, China | quality customizers, low emphasizers, mass servers, specialized contractors | Nine competitive capabilities (replicates Miller and Roth) | Self-Reporting |
| **Martin-Pena and Diaz-Garrido (2008)** | 353 Spanish manufacturers | manufacturers pursuing excellence and manufacturers focused on quality and delivery | Seven manufacturing competitive priorities | Self-Reporting |
| **Grant et al. (2012)** | 874 Ireland manufacturers | Best Value, Budget and Multi Focus | 11 operations priorities (replicates Miller and Roth) | Self-Reporting |

## A3

### Abbreviations

| | |
|---|---|
| LS | likert scale |
| P | Price |
| OR | Operating Revenue |
| OC | Operating Cost |
| AS | Annual Sales |
| CMR | Contribution Margin Ratio |
| SSI | Sales Seasonality Index |
| PSI | Price Seasonality Index |
| NOM | Number of Markdown |
| SOR | Stock Out Ratio |
| DRI | Delivery Reliability Index |
| IT | Inventory Turnover |
| DSI | Delivery Speed Index |
| SCI | Supply Chain index |
| EAF | Electrical Arc Furnace |
| RMS | Relative Market Share |
| ROA | Return on Asset |
| ROS | Return on Sales |
| GDP | Gross Domestic Production |
| LPG | Liquid Petroleum Gas |

## A4

## Formulas used in the research

| Manufacturing capability | Equation |
|---|---|
| Cost | |
| Price | Pn = (P1+P2+…+P12)n/12; n year |
| Operational Cost/Annual Sales | OCn/ASn; n year |
| Operational Revenue/Annual Sales | ORn/ASn; n year |
| Quality | |
| Quality Conformance | QMS certificate: Yes/No |
| Quality Performance | Product Standards: Yes/No |
| Delivery | |
| Delivery Reliability | DRn = AVG(CM;NOM;SOR)n |
| Contribution Margin | CMn = (Total sales – Total Cost )/Total Sales |
| Number of mark down | NOMn = Price Range / Average Price |
| Stock-Out Ratio | SORn = ( Total Sales – Inventory) / Total Sales |
| Delivery Speed | |
| Operating Cycle | OCn = DIO + DSO – DPO |
| Inventory Turnover | ITn = Total Sale / Inventory |
| Flexibility | |
| Product Mix | |
| Volume Flexibility | Product Line: Yes/No |
| Sales Seasonality Index | Sales Standard Deviation / Average Sales |
| Price Seasonality Index | Price Standard Deviation / Average Price |

| Performance Indicators | formula |
|---|---|
| **Relative Market Share** | Sales per Sum of Sample Sales |
| **Sale Growth %** | Percent of Change on Sales |
| **ROA** | Profitability per Total liability and Assets |
| **ROS** | Profitability per Total Sales |
| **Overall Performance** | Average Scaled Performance Indicators |

جامعة اليرموك
YARMOUK UNIVERSITY

كلية الاقتصاد والعلوم الإدارية
قسم إدارة الأعمال

الرقم: ك ق/107/50/
التاريخ: 24/ذو القعدة/1434 هـ
الموافق: 30/ايلول/2013 م

لمن يهمه الأمر

الموضوع: تسهيل مهمة

تحية طيبة وبعد،

ارجو العلم بأن طالب الماجستير اسامة محمد سليمان الجراح ورقمه الجامعي (2010360021) يقوم بإجراء دراسة ميدانية استكمالا لمتطلبات رسالته للماجستير والتي هي بعنوان :

*"التصنيفات لاستراتيجيات التصنيع لشركات الحديد والصلب في الأردن"*

لذا يرجى الموافقة على تسهيل مهمته وتقديم المعلومات التي يحتاجها لاكمال الدراسة. علماً بأن المعلومات ستعامل بمنتهى السرية وستستخدم لأغراض البحث العلمي فقط.

وتفضلوا بقبول فائق الاحترام والتقدير،،،

المشرف

د. يزن مقدادي

تلفون: ٧٢١١١١١ - ٢ - ٩٦٢+ فرعي ٦٦٠ فاكس: ٧٢١١١١٧ - ٢ - ٩٦٢+ ص.ب ٥٦٦ رمز بريدي ٦٣-٢١١ اربد - الأردن
Tel: +962-2-721111 Ext:2271 Fax: +962-2-7211147 B.O.Box566 Zep code:63-211 Irbid - Jordan Email: [illegible]

Form F1

Jordan

Ministry of High Education

Yarmouk University

Department of Business Admin

Dear Superintendent,

I am a Master candidate in Yarmouk University; I am doing a project about the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan with the period (2008-2012). I would be very thankful if you could assist this project by filling out the attached form.

The developed Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan are very important since the Iron and Steel Industry faced many challenges due to the global economic crisis in 2008 and the Jordanian recession in 2010.

Your cooperation in this research project will help in identifying The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan; the output of this research should be helpful to decision makers of Iron and Steel corporations.

Your anonymity will be protected, also the results will be presented in a form that will be prevent its identification, and furthermore, the confidentiality will be protected by deleting the data after the research project is complete, if you would like copy to this project to thank you for participation.

**If you have any concerns or any questions do not hesitate to contact the researcher on the following contacts**

**Osama Al-Jarrah**

**0795381726**

**Form F1**

**Iron and Steel corporation code :…………………..(for the researcher use).**

.

This form is concerned with identifying the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan. This Form is concerned about Steel Rebar Price ASTM 615 grade 60 for the period 200-2012; please fill out the prices for each month separately

| **Steel Price** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| January | | | | | |
| February | | | | | |
| March | | | | | |
| April | | | | | |
| May | | | | | |
| June | | | | | |
| July | | | | | |
| August | | | | | |
| September | | | | | |
| October | | | | | |
| November | | | | | |
| December | | | | | |

Form F2

Jordan

Ministry of High Education

Yarmouk University

Department of Business Admin

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**Osama Al-Jarrah**

**0795381726**

**Form F2**

**Iron and Steel corporation code :…………………..(for the researcher use).**

.

This form is concerned with identifying the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan. This Form is concerned about Steel Rebar Production/Sales for the period 200-2012; please fill out the Production/Sales for each quarter separately.

| **Production/Sales** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| Q1 | | | | | |
| Q2 | | | | | |
| Q3 | | | | | |
| Q4 | | | | | |

Form F4

Jordan

Ministry of High Education

Yarmouk University

Department of Business Admin



Dear Superintendent,

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**If you have any concerns or any questions do not hesitate to contact the researcher on the following contacts**

**Osama Al-Jarrah**

**0795381726**

**Form F4**

**Iron and Steel corporation code :…………………..(for the researcher use).**

.

This form is concerned with identifying the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan. This Form is concerned about your company Financial information for the period 200-2012; please fill out the financial records.

| **Income Records** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| Operating Revenue | | | | | |
| Operating Cost | | | | | |
| Net Profit | | | | | |

| **Assets and Liabilities** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| Account Payable | | | | | |
| Account Receivable | | | | | |

| **Financial Position** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| Total Assets and Liability | | | | | |

Form F5

Jordan
Ministry of High Education
Yarmouk University
Department of Business Admin

Dear Superintendent,

I am a Master candidate in Yarmouk University; I am doing a project about the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan with the period (2008-2012). I would be very thankful if you could assist this project by filling out the attached form.

The developed Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan are very important since the Iron and Steel Industry faced many challenges due to the global economic crisis in 2008 and the Jordanian recession in 2010.

Your cooperation in this research project will help in identifying The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan; the output of this research should be helpful to decision makers of Iron and Steel corporations.

Your anonymity will be protected, also the results will be presented in a form that will be prevent its identification, and furthermore, the confidentiality will be protected by deleting the data after the research project is complete, if you would like copy to this project to thank you for participation.

**If you have any concerns or any questions do not hesitate to contact the researcher on the following contacts**

**Osama Al-Jarrah**

**0795381726**

**Form F5**

**Iron and Steel corporation code :…………………..(for the researcher use).**

.

This form is concerned with identifying the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan. This Form is concerned about your company Inventory information for the period 200-2012; please fill out the Inventory records.

| Inventory Records | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| Average Inventory | | | | | |
| Steel Inventory | | | | | |

# Questionnaire Q3

Jordan

Ministry of High Education

Yarmouk University

Department of Business Admin

Dear Superintendent,

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The developed Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan are very important since the Iron and Steel Industry faced many challenges due to the global economic crisis in 2008 and the Jordanian recession in 2010.

Your cooperation in this research project will help in identifying The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan; the output of this research should be helpful to decision makers of Iron and Steel corporations.

Your anonymity will be protected, also the results will be presented in a form that will be prevent its identification, and furthermore, the confidentiality will be protected by deleting the data after the research project is complete, if you would like copy to this project to thank you for participation.

**If you have any concerns or any questions do not hesitate to contact the researcher on the following contacts**

**Osama Al-Jarrah**

**0795381726**

| Questionnaire Q3 |
|---|
| **Iron and Steel corporation code :…………………..(for the researcher use).** |

.

| |
|---|
| This form is concerned with identifying the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan. This Form is concerned about your company Quality certifications for the period 200-2012; please fill out the Quality certificates earned during the period 2008-2012 by **yes** or **No** in each box. |

| **Quality Conformance** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| ISO 9001:2008 | | | | | |
| ISO 14000:2004 | | | | | |
| Other QMS certificate | | | | | |

| **Quality Performance** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| JSS standards | | | | | |
| ASTM standards | | | | | |
| Other standards | | | | | |

Questionnaire Q5

Jordan

Ministry of High Education

Yarmouk University

Department of Business Admin

Dear Superintendent,

I am a Master candidate in Yarmouk University; I am doing a project about the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan with the period (2008-2012). I would be very thankful if you could assist this project by filling out the attached form.

The developed Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan are very important since the Iron and Steel Industry faced many challenges due to the global economic crisis in 2008 and the Jordanian recession in 2010.

Your cooperation in this research project will help in identifying The Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan; the output of this research should be helpful to decision makers of Iron and Steel corporations.

Your anonymity will be protected, also the results will be presented in a form that will be prevent its identification, and furthermore, the confidentiality will be protected by deleting the data after the research project is complete, if you would like copy to this project to thank you for participation.

**If you have any concerns or any questions do not hesitate to contact the researcher on the following contacts**

**Osama Al-Jarrah**

**0795381726**

**Questionnaire Q5**

**Iron and Steel corporation code :…………………..(for the researcher use).**

.

This form is concerned with identifying the Taxonomies of Iron and Steel Corporations' Manufacturing Strategies in Jordan. This Form is concerned about your company Products line-up for the period 200-2012; please fill out the Products line-up produced by the firm with period 2008-2012 by **yes** or **No** in each box.

| **Steel rebar products** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| Diameter: 8mm-12mm | | | | | |
| Diameter: 16mm-32mm | | | | | |
| Length: 6m-12m | | | | | |

| **Other products** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|
| Flat Bars | | | | | |
| Square Bars | | | | | |
| Plane round Bars | | | | | |
| Wire mesh | | | | | |
| Engineering Section | | | | | |
| Cut and Bend | | | | | |

| Company A1 | | |
|---|---|---|
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 896 | 1 |
| 2008 SD | 109 | 0.122383 |
| SP 2008 | 0.121651786 | 0.122383 |
| 2008 Range | 400 | 0.446429 |
| 2009 AVG | 595.4166667 | 1 |
| 2009 SD | 164.9856514 | 0.277093 |
| SP 2009 | 0.277092766 | 0.277093 |
| 2009 Range | 395 | 0.663401 |
| 2010 AVG | 517.0833333 | 1 |
| 2010 SD | 54.74977515 | 0.105882 |
| SP 2010 | 0.105881918 | 0.105882 |
| 2010 Range | 145 | 0.280419 |
| 2011 AVG | 615.8333333 | 1 |
| 2011 SD | 39.9336571 | 0.064845 |
| SP 2011 | 0.06484491 | 0.064845 |
| 2011 Range | 115 | 0.186739 |
| 2012 AVG | 623.75 | 1 |
| 2012 SD | 12.27062272 | 0.019672 |
| SP 2012 | 0.019672341 | 0.019672 |
| 2012 Range | 40 | 0.064128 |



| Company A1 | | |
|---|---|---|
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 154014 | 1 |
| AVG 2008 | 38503.5 | 0.25 |
| SD 2008 | 20430.09 | 0.1326508 |
| Total 2009 | 102406 | 1 |
| AVG 2009 | 25601.5 | 0.25 |
| SD 2009 | 14803.82 | 0.1445601 |
| Total 2010 | 81848 | 1 |
| AVG 2010 | 20462 | 0.25 |
| SD 2010 | 7664.362 | 0.0936414 |
| Total 2011 | 54723 | 1 |
| AVG 2011 | 13680.75 | 0.25 |
| SD 2011 | 4514.395 | 0.0824954 |
| Total 2012 | 92495 | 1 |
| AVG 2012 | 23123.75 | 0.25 |
| SD 2012 | 7197.945 | 0.0778198 |

| Company A1 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 5,133,800 | 2560150 | 1636960 | 1272628 | 2642714 |
| cost of sales per day | 380037.741 | 174266.573 | 116545.2726 | 99340.07557 | 159535.7235 |
| Average Inventory | 15715714.3 | 11378444.4 | 10231000 | 7015769.231 | 16516964.29 |
| days inventory outstanding | 41.3530358 | 65.2933276 | 87.78562843 | 70.62375572 | 103.5314469 |
| net sales per day | 380037.741 | 152599.319 | 116031.1898 | 94645.16667 | 159761.6481 |
| average accounts receivable | 5083068.28 | 2780233.2 | 1862900.94 | 652538.1763 | 2337987.846 |
| days sales outstanding | 13.3751671 | 18.2191717 | 16.05517398 | 6.89457475 | 14.63422463 |
| average accounts payable | 9,194,596 | 4,433,942 | 2,537,541 | 35,356 | 3,519,688 |
| days payable outstanding | 24.1939017 | 25.4434479 | 21.77300293 | 0.355912836 | 22.06206939 |
| Operating Cycle | 30.5343012 | 58.0690514 | 82.06779948 | 77.16241764 | 96.10360213 |
| Inventory Turnover | 8.706 | 5.514 | 4.101 | 5.097 | 3.477 |

| Company A1 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| Price | 896 | 595 | 517 | 615 | 623 |
| Operating Cost | 141023273.3 | 62,735,966 | 41956298.15 | 35762427.21 | 57432860.46 |
| OC/AP | 916 | 612 | 512 | 653 | 620 |
| Operating Revenue | 136,813,587 | 54,935,755 | 41,771,228 | 34,072,260 | 57,514,193 |
| OR/AP | 888 | 536 | 510 | 622 | 621 |
| Estimated Annual sales (tons) | 154014 | 102406 | 81848 | 54723 | 92495 |

| Company A1 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Quality Conformance

| | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 3 | 3 | 3 | 3 | 3 |

Quality Performance

| | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| Specific Orders | yes | yes | yes | yes | yes |
| Rating | 6 | 6 | 6 | 6 | 6 |

| Company A1 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Delivery reliability

| | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | -0.03077 | -0.14199 | -0.00443 | -0.04961 | 0.001414 |
| number of markdown | 0.446429 | 0.663401 | 0.280419 | 0.186739 | 0.064128 |
| Stock Out | 0.962476 | 0.953397 | 0.960811 | 0.962649 | 0.954051 |

Delivery Speed

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 30.5343 | 58.06905 | 82.0678 | 77.16242 | 96.1036 |
| Inventory Turnover | 8.705528 | 5.51358 | 4.100899 | 5.097435 | 3.477204 |

| Company A1 |
|---|
| Flexibility Analysis |

| Year | | | | | |
|---|---|---|---|---|---|
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| **Product Mix** | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | Yes | yes | yes | yes |
| 16mm-32mm | yes | Yes | yes | yes | yes |
| Flat Bars | No | No | no | no | no |
| Square Bars | No | No | no | no | no |
| Lengths Verity | yes | Yes | yes | yes | yes |
| Plane round Bars | yes | Yes | yes | yes | yes |
| Rating | 4 | 4 | 4 | 4 | 4 |
| | | | | | |
| Weighted Rating for P.M. | 4 | 4 | 4 | 4 | 4 |
| | | | | | |
| **Volume flexibility** | | | | | |
| | | | | | |
| Sales Seasonality index | 0.13265 | 0.14456 | 0.09364 | 0.08249 | 0.07782 |
| | | | | | |
| Price Seasonality index | 0.12238 | 0.27709 | 0.10588 | 0.06484 | 0.01967 |

| Company A2 | | |
|---|---|---|
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 865 | 1 |
| 2008 SD | 99 | 0.114881 |
| SD/AVG 2008 | 0.114450867 | 0.114881 |
| 2008 Range | 375 | 0.433526 |
| 2009 AVG | 533 | 1 |
| 2009 SD | 129.6695976 | 0.243283 |
| SD/AVG 2009 | 0.243282547 | 0.243283 |
| 2009 Range | 370 | 0.694184 |
| 2010 AVG | 517.0833333 | 1 |
| 2010 SD | 54.74977515 | 0.105882 |
| SP 2010 | 0.105881918 | 0.105882 |
| 2010 Range | 145 | 0.280419 |
| 2011 AVG | 616.5166667 | 1 |
| 2011 SD | 39.45367441 | 0.063994 |
| SD/AVG 2011 | 0.063994498 | 0.063994 |
| 2011 Range | 106.6 | 0.172907 |
| 2012 AVG | 623.75 | 1 |
| 2012 SD | 11.89442192 | 0.019069 |
| SD/AVG 2012 | 0.019069213 | 0.019069 |
| 2012 Range | 40 | 0.064128 |

| Company A2 | | |
|---|---|---|
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 161000 | 1 |
| AVG 2008 | 40250 | 0.25 |
| SD 2008 | 3403.43 | 0.0211393 |
| Total 2009 | 171000 | 1 |
| AVG 2009 | 42750 | 0.25 |
| SD 2009 | 5909.033 | 0.0345557 |
| Total 2010 | 193000 | 1 |
| AVG 2010 | 48250 | 0.25 |
| SD 2010 | 2362.908 | 0.012243 |
| Total 2011 | 176000 | 1 |
| AVG 2011 | 44000 | 0.25 |
| SD 2011 | 7527.727 | 0.0427712 |
| Total 2012 | 162000 | 1 |
| AVG 2012 | 40500 | 0.25 |
| SD 2012 | 2081.666 | 0.0128498 |

| Company A2 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 6661591 | 6350858 | 9257860 | 7426202 | 11027497.13 |
| cost of sales per day | 318682.133 | 179082.419 | 213585.1111 | 306418.6944 | 266788.8889 |
| Average Inventory | 16289633 | 17665567 | 22751504 | 26263917 | 28718581 |
| days inventory outstanding | 51.1156143 | 98.644898 | 106.5219569 | 85.71251518 | 107.6453413 |
| net sales per day | 295419.728 | 202934.647 | 229111.5167 | 329288.55 | 266972.2222 |
| average accounts receivable | 13465617 | 10343184 | 10158005 | 11605067 | 12421674 |
| days sales outstanding | 45.581306 | 50.9680537 | 44.33650978 | 35.24285008 | 46.52796421 |
| average accounts payable | 3168452 | 4215613 | 6484183 | 8495578 | 8567534 |
| days payable outstanding | 9.94235845 | 23.5400717 | 30.35877813 | 27.72539063 | 32.1135338 |
| Operating Cycle | 86.8 | 126.1 | 120.5 | 93.2 | 122.1 |
| Inventory Turnover | 7.043 | 3.649 | 3.380 | 4.20 | 3.344 |

| Company A2 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| Price | 865 | 533 | 493 | 616 | 623 |
| Operating Cost | 114,725,568 | 64,469,671 | 76890640 | 110310730 | 96044000 |
| OC/AP | 712 | 377 | 398 | 626 | 592 |
| Operating Revenue | 106,351,102 | 73,056,473 | 82480146 | 118543878 | 96110000 |
| OR/AP | 660 | 427 | 427 | 673 | 593 |
| Estimated Annual sales (tons) | 161000 | 171000 | 193000 | 176000 | 162000 |

| Company A2 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Quality Conformance

| | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 6 | 6 | 6 | 6 | 6 |

Quality Performance

| | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| BS4449:97 | yes | yes | yes | yes | yes |
| Specific Orders | yes | yes | yes | yes | yes |
| Rating | 6 | 6 | 6 | 6 | 6 |

| Company A2 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Delivery reliability

| | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | -0.07874 | 0.117536 | 0.067768 | 0.069452 | 0.000687 |
| number of markdown | 0.433526 | 0.694184 | 0.263692 | 0.172907 | 0.064128 |
| Stock Out | 0.937362 | 0.913069 | 0.887757 | 0.937355 | 0.885262 |

Delivery Speed

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 86.75456 | 126.0729 | 120.4997 | 93.22997 | 122.0598 |
| Inventory Turnover | 7.042858 | 3.649454 | 3.379585 | 4.200087 | 3.344316 |

| Company A2 |
| --- |
| Flexibility Analysis |

| Year | | | | | |
| --- | --- | --- | --- | --- | --- |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| Product Mix | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | Yes | yes | yes | yes |
| 16mm-32mm | yes | Yes | yes | yes | yes |
| Flat Bars | yes | Yes | yes | yes | yes |
| Square Bars | yes | Yes | yes | yes | yes |
| Lengths Verity | yes | Yes | yes | yes | yes |
| Plane round Bars | yes | Yes | yes | yes | yes |
| Rating | 6 | 6 | 6 | 6 | 6 |
| Weighted Rating for P.M. | 6 | 6 | 6 | 6 | 6 |
| Volume flexibility | | | | | |
| Sales Seasonality index | 0.021139 | 0.034556 | 0.012243 | 0.042771 | 0.01285 |
| Price Seasonality index | 0.114881 | 0.243283 | 0.100192 | 0.063994 | 0.019069 |

| Company A3 | | |
|---|---|---|
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 867 | 1 |
| 2008 SD | 126 | 0.145469 |
| SP 2008 | 0.14532872 | 0.145469 |
| 2008 Range | 760 | 0.426759 |
| 2009 AVG | 557 | 1 |
| 2009 SD | 108.7219138 | 0.195192 |
| SP2009 | 0.195191946 | 0.195192 |
| 2009 Range | 310 | 0.556553 |
| 2010 AVG | 525 | 1 |
| 2010 SD | 51.96152423 | 0.098974 |
| SP2010 | 0.098974332 | 0.098974 |
| 2010 Range | 180 | 0.342857 |
| 2011 AVG | 624.1666667 | 1 |
| 2011 SD | 41.22186828 | 0.066043 |
| SP2011 | 0.066043047 | 0.066043 |
| 2011 Range | 130 | 0.208278 |
| 2012 AVG | 625.8333333 | 1 |
| 2012 SD | 10.83624669 | 0.017315 |
| SP2012 | 0.017314908 | 0.017315 |
| 2012 Range | 50 | 0.079893 |



| Company A3 | | |
|---|---|---|
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 14500 | 1 |
| AVG 2008 | 7250 | 0.5 |
| SD 2008 | 3889.087 | 0.2682129 |
| Total 2009 | 17100 | 1 |
| AVG 2009 | 4275 | 0.25 |
| SD 2009 | 2207.601 | 0.1290994 |
| Total 2010 | 0 | #DIV/0! |
| AVG 2010 | #DIV/0! | #DIV/0! |
| SD 2010 | #DIV/0! | #DIV/0! |
| Total 2011 | 0 | #DIV/0! |
| AVG 2011 | #DIV/0! | #DIV/0! |
| SD 2011 | #DIV/0! | #DIV/0! |
| Total 2012 | 0 | #DIV/0! |
| AVG 2012 | #DIV/0! | #DIV/0! |
| SD 2012 | #DIV/0! | #DIV/0! |

| Company A3 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 1400650 | 2525000 | 750000 | 182,071 | 108,393 |

| | | | | | |
|---|---|---|---|---|---|
| cost of sales per day | 43521 | 24907 | 11524 | 8007 | 5180 |
| Average Inventory | 5523601 | 2268477 | 558839 | 1171774 | 479782 |
| days inventory outstanding | 126.918861 | 91.0791188 | 48.49372562 | 146.3468861 | 92.62319978 |

| | | | | | |
|---|---|---|---|---|---|
| net sales per day | 38107.9722 | 24336.8944 | 10732.525 | 7198.455556 | 5155.186111 |
| average accounts receivable | 103677.5 | 420790.5 | 1015800 | 370184.5 | 384830 |
| days sales outstanding | 2.72062495 | 17.2902299 | 94.64687946 | 51.42554499 | 74.64909932 |

| | | | | | |
|---|---|---|---|---|---|
| average accounts payable | 950189.5 | 17.2902299 | 794371.5 | 51.42554499 | 259738 |
| days payable outstanding | 21.8330361 | 0.0006942 | 68.93225699 | 0.006422716 | 50.14311639 |

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 107.8 | 108.4 | 74.2 | 197.8 | 117.1 |

| | | | | | |
|---|---|---|---|---|---|
| Inventory Turnover | 2.836 | 3.953 | 7.424 | 2.460 | 3.887 |



| Company A3 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| | | | | | |
| Price | 867 | 557 | 525 | 624 | 625 |
| | | | | | |
| Operating Cost | 15,667,46 | 8,966,399 | 4148620 | 2882456 | 1864776 |
| OC/AP | 1080 | 524 | #DIV/0! | #DIV/0! | #DIV/0! |
| | | | | | |
| Operating Revenue | 13,718,87 | 8,761,28 | 3863709 | 2591444 | 1855867 |
| OR/AP | 946 | 512 | #DIV/0! | #DIV/0! | #DIV/0! |
| | | | | | |
| Estimated Annual sales (tons) | 14500 | 17100 | 0 | 0 | 0 |

| Company A3 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Quality Conformance

| | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 6 | 6 | 6 | 6 | 6 |

Quality Performance

| | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| Specific Orders | no | no | no | no | no |
| Rating | 4 | 4 | 4 | 4 | 4 |

| Company A3 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Delivery reliability

| | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | -0.14204 | -0.02341 | -0.07374 | -0.1123 | -0.0048 |
| number of markdown | 0.426759 | 0.556553 | 0.342857 | 0.208278 | 0.079893 |
| Stock Out | 0.897903 | 0.7118 | 0.805886 | 0.929741 | 0.941594 |

Delivery Speed

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 107.8064 | 108.3687 | 74.20835 | 197.766 | 117.1292 |
| Inventory Turnover | 2.836458 | 3.952607 | 7.423641 | 2.459909 | 3.886715 |

| Company A3 |
|---|
| Flexibility Analysis |

| Year | | | | | |
|---|---|---|---|---|---|
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| Product Mix | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | Yes | yes | yes | yes |
| 16mm-32mm | yes | Yes | yes | yes | yes |
| Flat Bars | No | No | no | no | no |
| Square Bars | No | No | no | no | no |
| Lengths Verity | yes | Yes | no | no | no |
| Plane round Bars | No | No | no | no | no |
| Rating | 3 | 3 | 2 | 2 | 2 |
| Weighted Rating for P.M. | 3 | 3 | 2 | 2 | 2 |
| Volume flexibility | | | | | |
| Sales Seasonality index | 0.26821 | 0.12909 | #DIV/0! | #DIV/0! | #DIV/0! |
| Price Seasonality index | 0.14546 | 0.19519 | 0.09897 | 0.06604 | 0.01731 |

| Company A4 | | |
| --- | --- | --- |
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 852 | 1 |
| 2008 SD | 157 | 0.185335 |
| SP2008 | 0.1842723 | 0.185335 |
| 2008 Range | 535 | 0.627934 |
| 2009 AVG | 530.8333333 | 1 |
| 2009 SD | 154.8435183 | 0.291699 |
| SP2009 | 0.291698936 | 0.291699 |
| 2009 Range | 360 | 0.678179 |
| 2010 AVG | 485 | 1 |
| 2010 SD | 52.17975922 | 0.107587 |
| SP2010 | 0.107587132 | 0.107587 |
| 2010 Range | 130 | 0.268041 |
| 2011 AVG | 589.1666667 | 1 |
| 2011 SD | 33.15482505 | 0.056274 |
| SP2011 | 0.056274102 | 0.056274 |
| 2011 Range | 95 | 0.161245 |
| 2012 AVG | 581.25 | 1 |
| 2012 SD | 12.0839864 | 0.02079 |
| SP2012 | 0.020789654 | 0.02079 |
| 2012 Range | 40 | 0.068817 |



| Company A4 | | |
| --- | --- | --- |
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 10737 | 1 |
| AVG 2008 | 5368.5 | 0.5 |
| SD 2008 | 1518.441 | 0.1414214 |
| Total 2009 | 51489 | 1 |
| AVG 2009 | 12872.25 | 0.25 |
| SD 2009 | 4097.61 | 0.0795822 |
| Total 2010 | 17310 | 1 |
| AVG 2010 | 4327.5 | 0.25 |
| SD 2010 | 3672.006 | 0.212132 |
| Total 2011 | 15260 | 1 |
| AVG 2011 | 3815 | 0.25 |
| SD 2011 | 2544.35 | 0.1667333 |
| Total 2012 | 44244 | 1 |
| AVG 2012 | 11061 | 0.25 |
| SD 2012 | 1142.375 | 0.0258199 |

| Company A4 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 849,900 | 3511780 | 2185206 | 896502 | 2270943 |
| | | | | | |
| cost of sales per day | 23421.2944 | 49296.6694 | 28956.16667 | 28956.16667 | 61907.40833 |
| Average Inventory | 976091 | 2959137.93 | 2066865.672 | 2347692.308 | 2137184.813 |
| days inventory outstanding | 41.6753613 | 60.027137 | 71.37911919 | 81.07745527 | 34.52227885 |
| | | | | | |
| net sales per day | 27271.8417 | 51685.85 | 30615.49722 | 29832.575 | 61858.28611 |
| average accounts receivable | 429480 | 5148900 | 2163750 | 2180000 | 5530500 |
| days sales outstanding | 15.7481114 | 99.6191414 | 70.67499131 | 73.07448318 | 89.40596883 |
| | | | | | |
| average accounts payable | 261,210 | 1,756,408 | 461,940 | 275,072 | 982,099 |
| days payable outstanding | 11.1526565 | 35.6293423 | 15.95308538 | 9.499591311 | 15.86400535 |
| | | | | | |
| Operating Cycle | 46.2708162 | 124.016936 | 126.1010251 | 144.6523471 | 108.0642423 |
| | | | | | |
| Inventory Turnover | 8.638 | 5.997 | 5.043 | 4.440 | 10.428 |



| Company A4 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| | | | | | |
| Price | 852 | 531 | 485 | 589 | 581 |
| | | | | | |
| Operating Cost | 8431666 | 17746801 | 10424220 | 10424220 | 22286667 |
| OC/AP | 785 | 344 | 602 | 683 | 503 |
| | | | | | |
| Operating Revenue | 9817863 | 18606906 | 11021579 | 10739727 | 22268983 |
| OR/AP | 914 | 361 | 636 | 703 | 503 |
| | | | | | |
| Estimated Annual sales (tons) | 10737 | 51489 | 17310 | 15260 | 44244 |

| Company A4 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Quality Conformance

| | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 1 | 1 | 1 | 1 | 1 |

Quality Performance

| | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| Specific Orders | no | no | no | no | no |
| Rating | no | no | no | no | no |

| Company A4 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Delivery reliability

| | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | 0.141191 | 0.046225 | 0.054199 | 0.029378 | -0.00079 |
| number of markdown | 0.627934 | 0.678179 | 0.268041 | 0.161245 | 0.068817 |
| Stock Out | 0.913433 | 0.811265 | 0.801734 | 0.916525 | 0.898022 |

Delivery Speed

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 46.27082 | 124.0169 | 126.101 | 144.6523 | 108.0642 |
| Inventory Turnover | 8.638197 | 5.997288 | 5.043492 | 4.440199 | 10.42805 |

| Company A4 |
|---|
| Flexibility Analysis |

| Year | | | | | |
|---|---|---|---|---|---|
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| **Product Mix** | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | Yes | yes | yes | yes |
| 16mm-32mm | yes | Yes | yes | yes | yes |
| Flat Bars | No | No | no | no | no |
| Square Bars | No | No | no | no | no |
| Lengths Verity | yes | Yes | yes | yes | yes |
| Plane round Bars | No | No | no | no | no |
| Rating | 3 | 3 | 3 | 3 | 3 |
| Weighted Rating for P.M. | 3 | 3 | 2 | 2 | 2 |
| **Volume flexibility** | | | | | |
| Sales Seasonality index | 0.14142 | 0.07958 | 0.21213 | 0.16673 | 0.02582 |
| Price Seasonality index | 0.18533 | 0.29169 | 0.10758 | 0.05627 | 0.02079 |

| Company A5 | | |
|---|---|---|
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 913 | 1 |
| 2008 SD | 130 | 0.143116 |
| SP2008 | 0.142387733 | 0.143116 |
| 2008 Range | 405 | 0.443593 |
| 2009 AVG | 2009 AVG | 625 |
| 2009 SD | 2009 SD | 144.1662288 |
| SP2009 | SD/AVG 2009 | 0.230665966 |
| 2009 Range | 2009 Range | 415 |
| 2010 AVG | 536.25 | 1 |
| 2010 SD | 54.36095691 | 0.101372 |
| SP2010 | 0.101372414 | 0.101372 |
| 2010 Range | 175 | 0.32634 |
| 2011 AVG | 619.5833333 | 1 |
| 2011 SD | 36.52261649 | 0.058947 |
| SP2011 | 0.058947061 | 0.058947 |
| 2011 Range | 110 | 0.177539 |
| 2012 AVG | 627.0833333 | 1 |
| 2012 SD | 8.649312462 | 0.013793 |
| SP2012 | 0.013792924 | 0.013793 |
| 2012 Range | 25 | 0.039867 |

| Company A5 | | |
|---|---|---|
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 95332 | 1 |
| AVG 2008 | 23833 | 0.25 |
| SD 2008 | 7133.737 | 0.0748305 |
| Total 2009 | 85000 | 1 |
| AVG 2009 | 21250 | 0.25 |
| SD 2009 | 7474.847 | 0.0879394 |
| Total 2010 | 75000 | 1 |
| AVG 2010 | 18750 | 0.25 |
| SD 2010 | 7271.52 | 0.0969536 |
| Total 2011 | 134000 | 1 |
| AVG 2011 | 33500 | 0.25 |
| SD 2011 | 11834.56 | 0.0883176 |
| Total 2012 | 115000 | 1 |
| AVG 2012 | 28750 | 0.25 |
| SD 2012 | 4404.165 | 0.0382971 |

| Company A5 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 5,292,977 | 2686541 | 4157217 | 3822687 | 2919608 |
| | | | | | |
| cost of sales per day | 155596.356 | 90407.4083 | 83671.83611 | 193310.4639 | 171365.0528 |
| Average Inventory | 15554744 | 12090179 | 6705865 | 12090764 | 10215600 |
| days inventory outstanding | 99.9685625 | 133.729959 | 80.14482903 | 62.54583304 | 59.61308817 |
| | | | | | |
| net sales per day | 165575.586 | 94175.1944 | 94696.79722 | 216052.5417 | 180126.7667 |
| average accounts receivable | 2040900 | 3270307 | 3079003 | 4587992 | 5033293 |
| days sales outstanding | 12.3260926 | 34.7257791 | 32.5143309 | 21.23553819 | 27.94305973 |
| | | | | | |
| average accounts payable | 2,319,188 | 2899545 | 2001474 | 2415440 | 2552695 |
| days payable outstanding | 14.9051531 | 32.0719845 | 23.92052204 | 12.49513322 | 14.89624027 |
| | | | | | |
| Operating Cycle | 97.4 | 136.4 | 88.7 | 71.3 | 72.7 |
| | | | | | |
| Inventory Turnover | 3.601 | 2.692 | 4.492 | 5.756 | 6.039 |



| Company A5 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| | | | | | |
| Price | 913 | 625 | 536 | 619 | 627 |
| | | | | | |
| Operating Cost | 56,014,688 | 32,546,667 | 30121861 | 69591767 | 61691419 |
| OC/AP | 587 | 382 | 401 | 519 | 536 |
| | | | | | |
| Operating Revenue | 59,607,211 | 33,903,070 | 34090847 | 77778915 | 64845636 |
| OR/AP | 625 | 398 | 454 | 580 | 563 |
| | | | | | |
| Estimated Annual sales (tons) | 95330 | 85000 | 75000 | 134000 | 115000 |

| Company A5 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

| Quality Conformance | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 6 | 6 | 6 | 6 | 6 |

| Quality Performance | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| Specific Orders | no | no | yes | yes | yes |
| Rating | 4 | 4 | 6 | 6 | 6 |

| Company A5 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

| Delivery reliability | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | 0.06027 | 0.040008 | 0.116424 | 0.105262 | 0.048642 |
| number of markdown | 0.443593 | 0.664 | 0.32634 | 0.177539 | 0.039867 |
| Stock Out | 0.911202 | 0.920758 | 0.878055 | 0.950852 | 0.954976 |

| Delivery Speed | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 97.3895 | 136.3838 | 88.73864 | 71.28624 | 72.65991 |
| Inventory Turnover | 3.601132 | 2.691992 | 4.491868 | 5.755779 | 6.038942 |

Company A5

Flexibility Analysis

| Year | | | | | |
|---|---|---|---|---|---|
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| **Product Mix** | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | Yes | yes | yes | yes |
| 16mm-32mm | yes | Yes | yes | yes | yes |
| Flat Bars | No | No | no | no | no |
| Square Bars | No | No | no | no | no |
| Lengths Verity | yes | Yes | yes | yes | yes |
| Plane round Bars | No | No | no | no | no |
| Rating | 3 | 3 | 3 | 3 | 3 |
| | | | | | |
| Weighted Rating for P.M. | 3 | 3 | 3 | 3 | 3 |
| **Volume flexibility** | | | | | |
| Sales Seasonality index | 0.07483 | 0.08793 | 0.09695 | 0.08831 | 0.03829 |
| Price Seasonality index | 0.14311 | 0.23066 | 0.10137 | 0.05894 | 0.01379 |

| Company A6 | | |
|---|---|---|
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 880 | 1 |
| 2008 SD | 121 | 0.137947 |
| SP2008 | 0.1375 | 0.137947 |
| 2008 Range | 405 | 0.460227 |
| 2009 AVG | 527 | 1 |
| 2009 SD | 153.4037059 | 0.291089 |
| SP2009 | 0.291088626 | 0.291089 |
| 2009 Range | 418 | 0.793169 |
| 2010 AVG | 494.8333333 | 1 |
| 2010 SD | 57.53391622 | 0.116269 |
| SP2010 | 0.116269282 | 0.116269 |
| 2010 Range | 147 | 0.29707 |
| 2011 AVG | 588.9166667 | 1 |
| 2011 SD | 35.13210998 | 0.059655 |
| SP2011 | 0.059655486 | 0.059655 |
| 2011 Range | 106 | 0.179992 |
| 2012 AVG | 595.75 | 1 |
| 2012 SD | 19.40536477 | 0.032573 |
| SP2012 | 0.032573 | 0.032573 |
| 2012 Range | 66 | 0.110785 |

| Company A6 | | |
|---|---|---|
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 10000 | 1 |
| AVG 2008 | 10000 | 1 |
| SD 2008 | #DIV/0! | #DIV/0! |
| Total 2009 | 32200 | 1 |
| AVG 2009 | 8050 | 0.25 |
| SD 2009 | 185.458 | 0.0057596 |
| Total 2010 | 32001 | 1 |
| AVG 2010 | 8000.2 | 0.25 |
| SD 2010 | 217.6512 | 0.0068014 |
| Total 2011 | 32068 | 1 |
| AVG 2011 | 8017 | 0.25 |
| SD 2011 | 518.7466 | 0.0161765 |
| Total 2012 | 35000 | 1 |
| AVG 2012 | 8750 | 0.25 |
| SD 2012 | 285.7738 | 0.008165 |

| Company A6 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 639190 | 1729020 | 1158684.225 | 1039057.2 | 1940160 |
| cost of sales per day | 41452.7778 | 55711.1806 | 39028.95833 | 55584.66667 | 61250.38889 |
| Average Inventory | 1852725 | 3325038 | 3358505 | 2456400 | 4042000 |
| days inventory outstanding | 44.6948335 | 59.6834956 | 86.05161766 | 44.19204337 | 65.99141774 |
| net sales per day | 46045.2778 | 40751.3889 | 44742.5 | 55639 | 61114.58333 |
| average accounts receivable | 1091406.42 | 1789591.56 | 1783326.766 | 1785440.191 | 1877650.95 |
| days sales outstanding | 23.7028957 | 43.9148606 | 39.85755749 | 32.08972467 | 30.72345172 |
| average accounts payable | 703074.52 | 797944.235 | 1202144.122 | 202488.3644 | 174553.9433 |
| days payable outstanding | 16.9608542 | 14.3228743 | 30.80133761 | 3.64288169 | 2.849842204 |
| Operating Cycle | 51.4 | 89.3 | 95.1 | 72.6 | 93.9 |
| Inventory Turnover | 8.055 | 6.032 | 4.184 | 8.146 | 5.455 |

| Company A6 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| Price | 880 | 527 | 494 | 588 | 595 |
| Operating Cost | 14,923,000 | 20,056,025 | 14050425 | 20010480 | 22050140 |
| OC/AP | 1492 | 622 | 439 | 624 | 630 |
| Operating Revenue | 16,576,300 | 14,670,500 | 16107300 | 20030040 | 22001250 |
| OR/AP | 1657 | 455 | 503 | 624 | 628 |
| Estimated Annual sales (tons) | 10000 | 32200 | 32001 | 32068 | 35000 |

| Company A6 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Quality Conformance

| | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 3 | 3 | 3 | 3 | 3 |

Quality Performance

| | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| Specific Orders | yes | yes | yes | yes | yes |
| Rating | 5 | 5 | 5 | 5 | 6 |

| Company A6 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Delivery reliability

| | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | 0.099739 | -0.3671 | 0.127698 | 0.000977 | -0.00222 |
| number of markdown | 0.460227 | 0.793169 | 0.29707 | 0.179992 | 0.110785 |
| Stock Out | 0.96144 | 0.882143 | 0.928065 | 0.948125 | 0.911816 |

Delivery Speed

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 51.43687 | 89.27548 | 95.10784 | 72.63889 | 93.86503 |
| Inventory Turnover | 8.054622 | 6.031818 | 4.183536 | 8.146263 | 5.455255 |

| Company A6 |
| --- |
| Flexibility Analysis |

| Year | | | | | |
| --- | --- | --- | --- | --- | --- |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| **Product Mix** | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | Yes | yes | yes | yes |
| 16mm-32mm | yes | Yes | yes | yes | yes |
| Flat Bars | No | No | no | no | no |
| Square Bars | No | No | no | no | no |
| Lengths Verity | No | No | no | no | no |
| Plane round Bars | No | No | no | no | no |
| Rating | 2 | 2 | 2 | 2 | 2 |
| Weighted Rating for P.M. | 2 | 2 | 2 | 2 | 2 |
| **Volume flexibility** | | | | | |
| Sales Seasonality index | #DIV/0! | 0.00576 | 0.00680 | 0.01617 | 0.00816 |
| Price Seasonality index | 0.13794 | 0.29108 | 0.11627 | 0.05966 | 0.03257 |

| Company A7 | | |
|---|---|---|
| **Steel Price Analysis** | | |
| Date | ASTM 615 grade 60 | Percent |
| 2008 AVG | 898 | 1 |
| 2008 SD | 132 | 0.147755 |
| SP2008 | 0.146993318 | 0.147755 |
| 2008 Range | 375 | 0.417595 |
| 2009 AVG | 556 | 1 |
| 2009 SD | 163.6239915 | 0.294288 |
| SP2009 | 0.294287755 | 0.294288 |
| 2009 Range | 383 | 0.688849 |
| 2010 AVG | 488.75 | 1 |
| 2010 SD | 54.98450195 | 0.1125 |
| SP2010 | 0.11250026 | 0.1125 |
| 2010 Range | 150 | 0.306905 |
| 2011 AVG | 588.3333333 | 1 |
| 2011 SD | 34.98917582 | 0.059472 |
| SP2011 | 0.059471687 | 0.059472 |
| 2011 Range | 95 | 0.161473 |
| 2012 AVG | 577.25 | 1 |
| 2012 SD | 14.33447846 | 0.024832 |
| SP2012 | 0.024832358 | 0.024832 |
| 2012 Range | 50 | 0.086618 |

| Company A7 | | |
|---|---|---|
| Production/Sales Analysis | | |
| Production | Actual | percent |
| Total 2008 | 30881 | 1 |
| AVG 2008 | 7720.25 | 0.25 |
| SD 2008 | 542.8963 | 0.0175803 |
| Total 2009 | 24181 | 1 |
| AVG 2009 | 6045.25 | 0.25 |
| SD 2009 | 589.0526 | 0.0243601 |
| Total 2010 | 28264 | 1 |
| AVG 2010 | 7066 | 0.25 |
| SD 2010 | 1163.737 | 0.0411738 |
| Total 2011 | 30733 | 1 |
| AVG 2011 | 7683.25 | 0.25 |
| SD 2011 | 1464.806 | 0.0476623 |
| Total 2012 | 29452 | 1 |
| AVG 2012 | 7363 | 0.25 |
| SD 2012 | 331.9682 | 0.0112715 |

| Company A7 | | | | | |
|---|---|---|---|---|---|
| Inventory Analysis | | | | | |
| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
| Rebars Inventory | 3,168,416 | 3,747,395 | 3,151,499 | 1,276,271 | 592,631 |
| | | | | | |
| cost of sales per day | 65865.7833 | 41466.3278 | 45204.18056 | 30247.31667 | 33002.13056 |
| Average Inventory | 9870456 | 8436088.5 | 5989051.5 | 3557154.5 | 2693776.5 |
| days inventory outstanding | 149.857111 | 203.444311 | 132.4888855 | 117.6023162 | 81.62432106 |
| | | | | | |
| net sales per day | 60141.6667 | 38130.5556 | 42286.16111 | 34939.21111 | 39252.68889 |
| average accounts receivable | 4050595.4 | 3051495.55 | 3155098.802 | 2328814.761 | 2034135.857 |
| days sales outstanding | 67.3509004 | 80.0275659 | 74.6130346 | 66.65332979 | 51.82156725 |
| | | | | | |
| average accounts payable | 3,289,235 | 2850831.34 | 1980170.616 | 1259526.808 | 985178.4406 |
| days payable outstanding | 49.9384475 | 68.7505138 | 43.80503289 | 41.64094361 | 29.85196483 |
| | | | | | |
| Operating Cycle | 167.269564 | 214.721363 | 163.2968872 | 142.6147024 | 103.5939235 |
| | | | | | |
| Inventory Turnover | 2.4022884 | 1.76952601 | 2.717209061 | 3.061164197 | 4.410450162 |

| Company A7 | | | | | |
|---|---|---|---|---|---|
| Cost Analysis | | | | | |
| | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| | | | | | |
| Price | 898 | 556 | 488 | 588 | 577 |
| | | | | | |
| Operating Cost | 23,711,682 | 14,927,878 | 16273505 | 10889034 | 11880767 |
| OC/AP | 767 | 617 | 575 | 354 | 403 |
| | | | | | |
| Operating Revenue | 21,651,000 | 13,727,000 | 15223018 | 12578116 | 14130968 |
| OR/AP | 701 | 567 | 538 | 409 | 479 |
| | | | | | |
| Estimated Annual sales (tons) | 30881 | 24181 | 28264 | 30733 | 29452 |

| Company A7 | | | | | |
|---|---|---|---|---|---|
| Quality Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Quality Conformance

| | | | | | |
|---|---|---|---|---|---|
| ISO 9001/2008 | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept | QA/QC dept |
| Rating | 1 | 1 | 1 | 1 | 1 |

Quality Performance

| | | | | | |
|---|---|---|---|---|---|
| Jordanian Standards (JIS) | yes | yes | yes | yes | yes |
| ASTM 615 | yes | yes | yes | yes | yes |
| Specific Orders | no | no | no | no | no |
| Rating | 4 | 4 | 4 | 4 | 4 |

| Company A7 | | | | | |
|---|---|---|---|---|---|
| Delivery Analysis | | | | | |
| Year | | | | | |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |

Delivery reliability

| | | | | | |
|---|---|---|---|---|---|
| Contribution Margin Ratio | -0.09518 | -0.08748 | -0.06901 | 0.134287 | 0.159239 |

| | | | | | |
|---|---|---|---|---|---|
| number of markdown | 0.417595 | 0.688849 | 0.306905 | 0.161473 | 0.086618 |

| | | | | | |
|---|---|---|---|---|---|
| Stock Out | 0.85366 | 0.727006 | 0.792978 | 0.898532 | 0.958062 |

Delivery Speed

| | | | | | |
|---|---|---|---|---|---|
| Operating Cycle | 167.2696 | 214.7214 | 163.2969 | 142.6147 | 103.5939 |

| | | | | | |
|---|---|---|---|---|---|
| Inventory Turnover | 2.402288 | 1.769526 | 2.717209 | 3.061164 | 4.41045 |

| Company A7 |
| --- |
| Flexibility Analysis |

| Year | | | | | |
| --- | --- | --- | --- | --- | --- |
| Index | 2008 | 2009 | 2010 | 2011 | 2012 |
| Product Mix | | | | | |
| | | | | | |
| Steel Sections | | | | | |
| 8mm-12mm | yes | yes | yes | yes | yes |
| 16mm-32mm | yes | yes | yes | yes | yes |
| Flat Bars | No | no | no | no | no |
| Square Bars | No | no | no | no | no |
| Lengths Verity | yes | yes | yes | yes | yes |
| Plane round Bars | No | no | no | no | no |
| Rating | 3 | 3 | 3 | 3 | 3 |
| Weighted Rating for P.M. | 3 | 3 | 3 | 3 | 3 |
| Volume flexibility | | | | | |
| Sales Seasonality index | 0.01758 | 0.02436 | 0.04117 | 0.04766 | 0.01127 |
| Price Seasonality index | 0.14775 | 0.29428 | 0.1125 | 0.05947 | 0.02483 |

**أسامه محمد سليمان الجراح**

# التصنيفات لإستراتيجيات التصنيع لشركات الحديد و الصلب في الأردن


**الملخص:**

تواجه صناعة الحديد و الصلب في الأردن العديد من التحديات و الصعوبات نتيجة للأزمة الاقتصادية العالمية في عام ٢٠٠٨ والركود الاقتصادي الأردني في عام ٢٠١٠، و قد سعت هذه الشركات لاستمرار بقائها عبر تعزيز ميزتها التنافسية من خلال تقليل الكلفة و تحسين الجوده و السرعة في التسليم و المرونة. هدفت هذه الدراسة الى تحديد التصنيفات لإستراتيجيات التصنيع لشركات الحديد والصلب في الأردن خلال هذه الفترة الحرجة الممتدة من عام ٢٠٠٨ الى عام ٢٠١٢.

اعتمدت هذه الدراسة في توثيق متغيراتها على الحقائق المنشورة في التقارير السنوية و القوائم المالية و شهادات الجودة و تقارير الانتاج و المبيعات و غيرها من الإحصائيات. اتاحت هذه المنهجية للباحث تحديد التصنيفات لإستراتيجيات التصنيع المؤقته و المستدامة و الطارئة، بينما اعتمدت الدراسات السابقة على منهجية الدراسة اللحظية (snapshot self-reporting methodology) من خلال وجهة النظر الشخصية للمستجيبين.

و قد شملت الدراسة عينة مكونة من سبعة شركات من أصل أربعة عشر شركة أردنية مصنعة للحديد و الصلب؛ وهو ما يمثل حوالي ٨٠٪ من الحصص السوقية لشركات الحديد و الصلب الأردنية خلال الفترة ٢٠٠٨-٢٠١٢. استخدم الباحث (K-mean) التحليل العنقودي لتحديد المجموعات الإستراتيجية الصناعية، كما استخدم

الباحــث اختبـــار (Kraskul Wallis) لتحديــد القــرارات و مؤشــرات الأداء المتــأثرة بالمجموعات الإستراتيجية الصناعية.

و توصــل البحــث الــى ثلاثــة أســاليب لتكــوين المجموعــات الإســتراتيجية الصــناعية: و هــي المؤقتــة و المســتدامة و الطارئــة. طبقــا لتعريــف الإســتراتيجية المؤقتــة تــم تشــكيل ثــلاث مجموعــات اســتراتيجية صــناعية مــن خــلال ثــلاث عناصــر تنافســية، و حســب تعريــف الاســتراتيجية المســتدامة تشــكلت ثــلاث مجموعــات اســتراتيجية صــناعية مــن خــلال ثــلاث عناصــر تنافســية، بينمــا تشــكلت ثــلاث مجموعــات اســتراتيجية صــناعية مــن خــلال عنصــر التكلفة وفقا لتعريف الاستراتيجية الطارئة.

كلمــــات مفتاحيــــة: إدارة العمليــــات، إســــتراتيجيات العمليــــات، إســــتراتيجيات التصــــنيع، تصنيفات، صناعة الحديد و الصلب، الأردن.